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Concrete and Road Number

THIS issue, appearing just before the annual meetings of the American Concrete Institute and of the American Road Builders' Association, with their accompanying exhibitions of materials and machinery, is devoted almost exclusively to articles on concrete and road work. Upon the subject of highways, it has been the aim to cover the several types of pavement now in general use. The reader will find articles on sheet asphalt for resurfacing old macadam, brick upon concrete foundation, methods of filling joints in granite block and the paving of the main business streets of a New Jersey town with concrete. The economics of highways is accounted for by an article describing a business basis for the selection of road types. A better understanding of these principles would do much to reduce the present enormous waste of money expended on highway construction. Then, too, there is an account of what the Massachusetts Highway Commission accomplished last year. So much for the highway articles. For the concrete engineer and contractor there is a wealth of material—a huge waterfront structure at Hoboken, one of the largest in the country; a concrete coal-storage pit; a munitions plant covering 11 acres and completed on schedule time; a concrete bridge of artistic design; structures of the Boston subway which received special treatment on their surfaces. But why continue? The pages which follow are the best evidence that the Engineering Record realizes that this is the week of the road builder and of the concrete engineer.

Acceptance Day

THE closing paragraph of Mr. Bentley's article, on page 184 of this issue, carries a suggestion that is worth while passing on to other communities. The paving of the main business streets at Lakewood, N. J., was made the occasion of community rejoicing. Of course this is impossible with every piece of engineering work successfully completed, but where a main artery of a town or an important work—a new water supply or a bridge—is involved, opportunity is afforded to link up in the minds of the citizens the engineer's relation to the welfare of the community. This has been done in the case of monumental works constructed for big cities, but is rather infrequent in connection with the smaller construction. The promotion of the idea must originate with the engineer. He will find no difficulty in securing the co-operation of civic organizations.

Another View of Grade Separation

UNDER LAWS that throw the whole cost of grade-crossing elimination on the railroads it is easy to see the deadliness of grade crossings and demand that they be abolished regardless of expense. Where state and municipality have to pay their fair share, however, the questions are much more likely to be looked at from all angles. The New York Public Service Commission, Second District, states in its 1916 report, just issued, that there developed during the year a number of grade-crossing applications in which the cost of elimination was far out of proportion to the greater degree of safety to be attained. The commission deplores the fact that it is without power to order slight changes in the physical surroundings that would in many cases render such grade crossings reasonably safe. Again, the commission cites a typical case where it denied a petition because the elimination plan would have introduced greater dangers than those removed. This was because the plan called for a highway intersection just beyond, and obscured by, the underpass. The autoist might, therefore, pass under the train in safety only to collide with another vehicle on the cross road; it seems reasonable in such a case to leave the grade crossing and expect the autoist to heed the warning signs. The point is that when one's own pocketbook is affected one is much more likely to study the matter carefully and see whether the expenditure is warranted.

Sectionalizing a Society

THE Illinois Society of Engineers seeing clearly the vision of competitors arising about it, sapping with all the strength of youth the vigor of its own stanch growth of thirty-two years, has lost no time in providing amply under its own guiding hand for the various groups of its membership interested in surveying, roads and pavements, drainage, water supply and sewerage. The real awakening came last spring at a conference on drainage held at the University of Illinois and attended by nearly as many men as come to the state society meetings, though the leading spirits were practically all members of the society. After a helpful program had been finished the question of a permanent organization arose. The question whether to revise the nearly moribund Drainage and Levee District Association or to create in the engineers' society a definite, substantial place for the activities of this group of men —many of whom were lawyers, commissioners and operators—was quickly decided in favor of the latter proposal. The new plan, with its non-technical requirements and halved dues for section membership, should attract all those interested in the purpose of the different sections. It should solve that difficult problem, the arrangement of a program interesting to the greatest number. A surfeit of specialized papers, extremely interesting to a few, can now be disposed of with ease. Sections on unrelated subjects, such as drainage and structural engineering, can hold simultaneous meetings, and a two-day meeting will then give ample time for discussion. The working of the plan will be watched with keen interest by other state societies, which in late years have been groping to find themselves. The Illinois Society of Engineers may not have found the solution of the whole problem of the state society, but it is facing in the right direction and should receive hearty support.

A Time-Study of Conventions

SOME day some one will make a convincing protest against the American habit of carrying on our education in public. Perhaps there is no reason why this should be mentioned in particular connection with the recent convention of the American Wood Preservers' Association except that here is a large gathering of men who, like the men said to have surrounded a former president, should know exactly what they want. It is not quite clear why committees do not or cannot extract from the various points in their reports those of particular novelty, or those which they should know will arouse contention, and so state them that it is obvious just why the certain decision was reached. Surely men engaged in so specialized an industry as timber treatment should sense immediately these matters. Similarly, members who have had the printed reports for some days could digest their objections and so arrange them that their presentation would occupy seconds rather than minutes. As free-born American citizens we have the inalienable right to do as we please, apparently. But cannot we study our papers and reports for an hour or so, find the form in which the salient points may best be presented, to the end that, in the aggregate, many man-days will be saved?

Saving Money on Building Work

THE variable factors in concrete-building construction can be reduced so nearly to certainties that it is possible to predict the day and date of a result, such as the completion of a floor, to which many complicated operations contribute. So sure was the Aberthaw Construction Company of its advance schedule for the erection of the Colt's Arms Company's building in Hartford, Conn., that before work was started it published the date on which each floor would be completed. It then proceeded to carry out the schedule to a day, as told on page 186 of this issue. This is not the first building which this firm has constructed to schedule; in fact, all its work is handled in this way. Neither is this the only firm which time-schedules all its work. The able planning and accurate office knowledge of field conditions which such feats imply are fast becoming prerequisite to any great measure of success in building construction. This company, however, is reputed to have gone farther than most along the path of construction efficiency, especially in the matter of handling the human elements of its organization. It saves money to employ the skill and foresight that makes possible such planning. It saves money to bring the human organization to such a pitch of efficiency that it can carry out these plans. Contractors in other lines can help themselves greatly by a study of methods that bring such results.

Education for Fire Prevention

AN OUTLET for the energies of the engineer who wishes to do his part in the improvement of civic conditions is afforded by the proposal of the National Fire Protection Association that instruction be given, especially in the schools, to impress on the public the facts regarding the waste, the cause and the prevention of fire. The association has prepared an excellent syllabus as a basis for instruction. The points are brought out emphatically by means of comparisons and by translating the figures into readily comprehended units. For example, the extent of the average annual fire loss in America, $230,000,000, based upon the last 10-year period, is emphasized by the statement that it is equivalent to the loss of a $4,000 home every 10 minutes, and that the year 1915 with twenty-six fires, involving individual losses ranging from $500,000 to $200,000,000, is a sample average year. The average annual per capita loss of 33 cents in Europe is compared with $3 for the United States and Canada, not including the cost of mantaining fire departments. "Fire insurance does not replace lost property," and "Every fire is paid for by all the people" are two striking sentences used in pointing out the true economic significance of fire waste.

Worthy of strong indorsement by engineers are the proposals that the public authorities should certify to proper construction of chimneys and heating facilities, that the storage, handling and use of explosives should be regulated, that fire departments should make regular inspections to enforce the removal of rubbish and other fire-breeding dangers, that state building codes should regulate all building construction, that the use of untreated wood shingles in closely built-up communities should be forbidden and that ordinary windows should be replaced by metal frames and wire glass or by standard fire shutters in the commercial and business districts.

Many cities have made progress in the matter of building regulations looking to fire resistance. But the fact that our fire losses continue at enormous figures is eloquent testimony that there is still much to be done in the way of real fire prevention. More rapid progress can be obtained through the educational work proposed by the National Fire Protection Association. Engineers can help by proffering their services to civic organizations which take up such educational work and by urging its initiation wherever they can make their influence felt.

Colonization After the War

As a field for speculation, the readjustment of foreign industry to peace conditions has been fruitful. What will the nations do with their soldiers when the war is over? On the details of this great subject opinion is widely at variance, but there seems to be fairly general agreement on one main theme—that in the period of reconstruction the human elements of the industrial problem will reach new levels of importance. The signs all point that way. To engineers one of the most interesting of recent developments is the great Canadian colonization scheme which contemplates the use of land in the region of the Winnipeg Aqueduct by returning soldiers. Already the officials of the Greater Winnipeg Water District, in co-operation with the dominion and provincial governments, are at work upon the project. Some of its details were set forth this month in an article by A. A. Stoughton of the University of Manitoba, appearing in the *Manitoba Free Press*. The dominion government is to give the land, the provincial government is to make the physical improvements, such as roads and drainage, while the Water District is to construct the community center, together with school houses, playgrounds, public meeting halls, etc.

The success of such a settlement, as Mr. Stoughton points out, depends upon the thorough planning of all its features, physical and social as well as agricultural and economic. Here is a field in which the engineer has big opportunities to use his specialized knowledge. Another settlement plan is to be put in operation at once by the Canadian Pacific Railroad for men who have served with Canadian units in the British forces. Improvements in the form of houses, barns, water supply and other accessories are to be made by the company. The colonists will be tenants for three years, not making any payment of rent during that period. After three years, however, an amount equal to 6 per cent on the cost of permanent improvements will be charged for each year that has passed since the colonists went into occupation. Under an alternative plan land will be sold to settlers on a 20-year basis, the first payment not being due till the end of the second year.

Engineers and others familiar with the various reclamation projects in this country, with the activities of the land speculators and with the collapse of many little homestead projects due to unsound financial policies which were permitted to exist by the powers in charge, will follow with interest the working out of the Canadian colonization scheme.

While these projects are primarily in the field of agriculture, it is not unreasonable to expect in the regeneration of the industrial activities of the nations now at war similar provisions regarding the human features. We may reasonably look for a great deal more of the so-called welfare work in industry—work which will involve not merely better housing, but opportunities for recreation and education. In some large American manufacturing plants to-day marked progress along these lines has been made. Under the stimulus of European example after the war, this work will assume in the United States a broad scope, and if the engineer will take his part in it, he is certain to attain a new prominence.

Shall Convicts Be Used on the Roads?

THE OBJECTIONS urged against convict labor are many and varied. They range from arguments based on economics to those which apparently seem to have the most humanitarian foundations. Whatever solution of the problem may be found, it will inevitably be pragmatic and its criterion will be, "Does it work?" That it has worked cannot be denied, for in certain sections the prison authorities have not only succeeded in constructing excellent roads at a cost far below that possible with free labor, but have attained the much-needed end of making the convict realize that road work is honorable labor and a mark of his potential fitness to live again with society. When it has been possible to dispense with chains and the too obvious presence or armed guards, the much-feared debasing effect upon the public disappears.

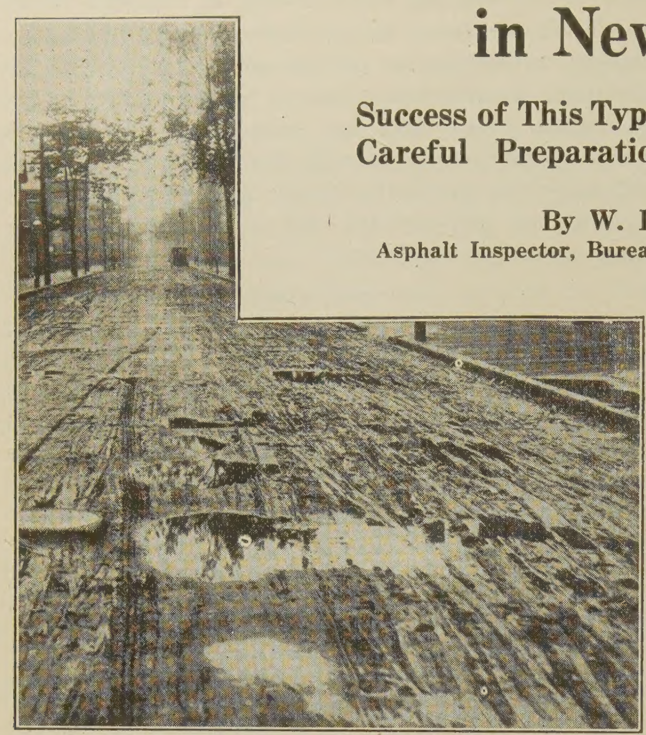
But of course the essential human quality of the problem will prevent its perfection to any greater degree than, say, our educational system. The fact that our schools, though they inculcate discipline and spend years upon the three R's, neither assure honest nor accurate clerks and engineers is no reason for dismissing the teachers and closing the classrooms. One success justifies a hundred failures, for to such small percentages is all progress due. Nor should the hardships of working during the winter months force northern sections to decide against the convict building of roads, for there are many germane tasks better carried on under cover—for instance, the fabrication of concrete culverts, bridge-floor slabs and the like.

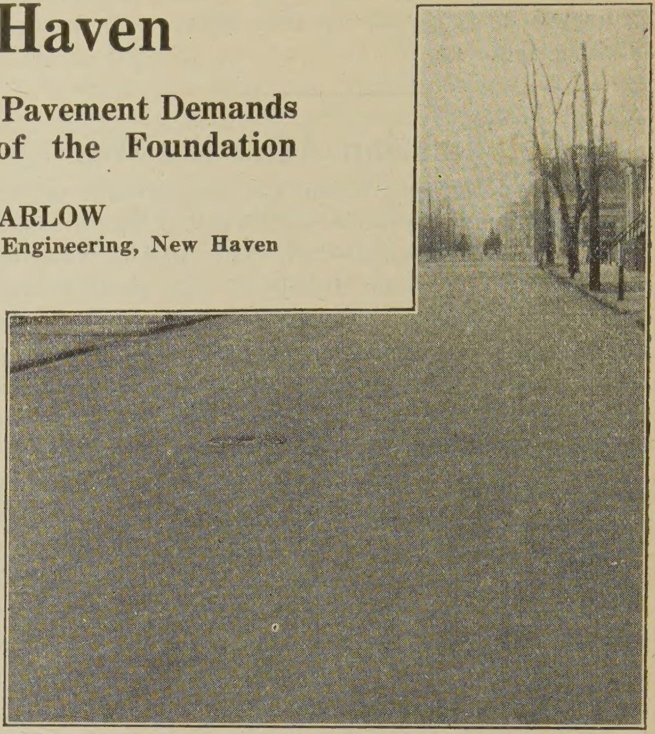
Such matters as the last mentioned are of the type which study will solve and which now constitute the basis of the opposition to a widespread employment of convicts on those public works where they interfere least with free labor. It must be admitted that it will not do to let prisoners "rot in their cells," and this is, in itself, a sufficient answer to the statement that such labor is inefficient. But there is not a single reason why road building should present a more difficult problem of organization than, say, the manufacture of shoes, and the greater chance of escape must balance to only a small degree the greater healthfulness of outdoor work and the opportunity of returning to society—not a health-broken, degenerate wreck, but a unit whose physical well-being is excellent and whose moral attitude has had every opportunity of improving.

Old Macadam Resurfaced with Sheet Asphalt in New Haven

Success of This Type of Pavement Demands Careful Preparation of the Foundation

By W. L. HARLOW
Asphalt Inspector, Bureau of Engineering, New Haven





THE SAME STREET BEFORE AND AFTER LAYING SHEET ASPHALT ON OLD MACADAM SURFACE

DURING the season of 1916 the city of New Haven, Conn., contracted to have 98,868 sq. yd. of old pavement resurfaced with sheet asphalt. This old pavement, covering twenty-two streets, consisted of about 92,000 sq. yd. of old waterbound macadam surface and of about 7000 sq. yd. of old brick, concrete or Belgian block surface. The work was started in May and completed in December, and all kinds of troubles were encountered, from railroad embargoes on paving material to labor strikes on the work. In spite of these difficulties the contractor managed to lay an average of 760 sq. yd. of finished 3-in. pavement per working day on old macadam surface and an average of 1220 sq. yd. of finished 2-in. pavement on old brick or block surface.

The traffic yardage on the resurfaced streets was as follows: Heavy traffic, 21,480 sq. yd.; moderate traffic, 52,090 sq. yd.; light traffic, 25,298 sq. yd.

MACADAM STREETS BADLY WORN

The picture accompanying this article, showing the condition of one of the streets before being improved, is fairly typical and offers a marked contrast to the views of the same street from the same location after improvement. All the old waterbound surfaces had either straight macadam or Telford macadam foundations, with brick or cobble gutters and flag and cobble crosswalks. The grades were mostly light and in no case exceeded 4 per cent. The streets were badly worn in the center, in some cases being 2 or 3 in. below the manhole covers. This condition caused an abrupt change of crown at the shoulders, which in most cases had to be taken down or graded up from the gutters. The policy throughout, however, was to leave the old macadam undisturbed as much as possible, and the new grades were fitted to the streets with this in mind. No attempt was made to adhere to any fixed rule for grade and crown.

The specifications for this work were drawn from the standards of the American Society of Municipal Improvements for sheet asphalt pavements, modified, of course, to meet the existing conditions and with a few additional clauses necessary for resurfacing work. Except where the resurfacing was done on old brick or Belgian-block surfaces, the contract called for 3 in. of pavement, consisting of 1½ in. of binder course and 1½ in. of wearing surface. On old brick or Belgian-block streets 2 in. of wearing surface was used with no binder course.

EXTRA BINDER

All binder that was used in a street in excess of the estimated quantity required to cover the street with a 1½-in. course was known as extra binder and was paid for extra by the short ton. However, the price of this binder was not allowed by the contract to exceed 15 cents per square yard, and when this occurred it was a loss to the contractor.

This practice was found to be more or less unsatisfactory, owing to the fact that the weight of 1 sq. yd. of binder 1½ in. thick was a variable, and on this account it was impossible to compute with certainty the quantity of extra binder. This consequently worked as an injustice to the contractor in one case and a loss to the city in the other. It is therefore recommended, in order to eliminate this unfairness to both parties, that all binder be bought by the short ton in place on the street, and that the present practice of buying the wearing surface by the square yard be continued. The pavements were guaranteed for 5 years by the contractor.

The mineral aggregate of the binder course consisted of 75 to 80 per cent by weight of crusher-run broken traprock, all passing a ¾-in. screen and retained on a ¼-in. screen, and 20 to 25 per cent of sand for a filler. This was incorporated with 4.5 to 5.5 per cent by weight of refined Mexican asphaltic cement, and a fairly close binder resulted. The wearing surface contained from 10.5 to 11.5 per cent of refined Mexican asphalt, and the mineral aggregate was for the most part bank-run sand, of which the following screening is representative:

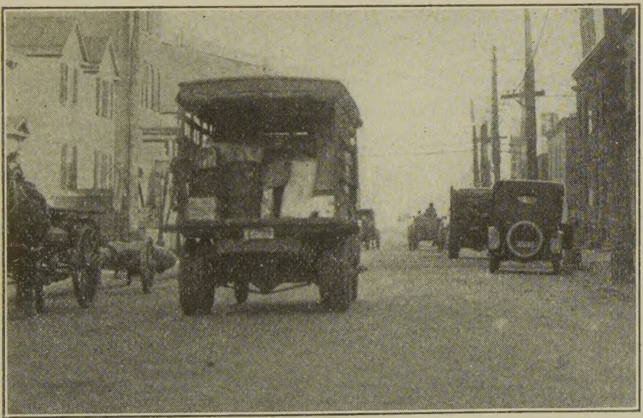
GRADING OF SAND USED IN ASPHALT MIXTURE

	Per Cent		Per Cent
Passing No. 200 screen	5.0	Passing No. 30 screen	13.0
Passing No. 100 screen	16.0	Passing No. 20 screen	8.0
Passing No. 80 screen	5.0	Passing No. 10 screen	4.0
Passing No. 50 screen	25.0	Retained on No. 8 screen	0.0
Passing No. 40 screen	24.0		

The grains in this sand were chiefly quartz, rough-surfaced, and had considerable clayey material adhering to them, which required somewhat more than the normal amount of bitumen to coat them thoroughly. On light traffic streets a coarser sand was mixed with this aggregate, which brought the larger screenings up somewhat. Limestone dust was used as a filler and was added in such quantities as was necessary to bring the total mineral aggregate passing the No. 200 screen up to 10 per cent. On the heavy-traffic streets this was increased to 13 per cent. All the asphaltic cement was 99.9 per cent bitumen soluable in carbon disulphide and carbon tetrachloride. The penetration of the asphaltic cement varied from 50 to 60, the harder material going on the heavy-traffic streets and the softer material on the light-traffic streets, 55 penetration being used on moderate-traffic streets.

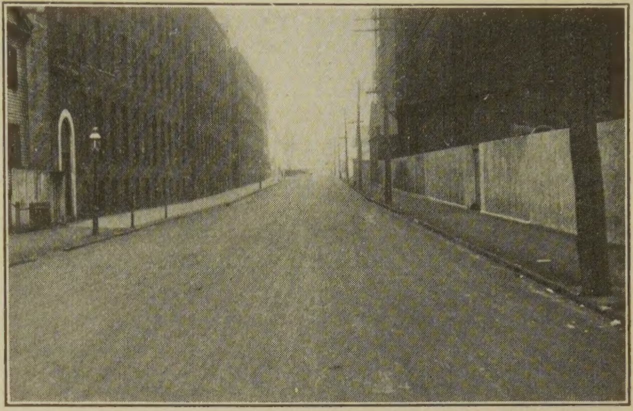
MOTOR TRUCKS HAUL ASPHALT

A No. 2 one-car Merriman asphalt plant was used on this work. The plant was set up on a spur track which was centrally located to handle all the work done. In no case did the round-trip haul exceed 4 miles, and averaged about 2 miles. Sand and broken stone were received in part by rail at the plant and the rest was hauled by truck at night. All asphaltic cement was received in tank cars by rail except when railroad embargoes held up the delivery of the material; then, to keep the plant in operation, the kettles were charged from a supply of asphaltic cement in metal drums kept on hand for such emergencies. Five-ton Pierce-Arrow motor trucks were used to haul practically all the hot stuff to the streets, and besides doing service during the daytime were used considerably at night to haul sand and other materials.



AVERAGE TRAFFIC CONDITIONS ON ONE OF NEW HAVEN'S RESURFACED STREETS

The streets were prepared for resurfacing entirely by the city's forces, the contractor, however, being required by contract to broom the streets thoroughly before applying the binder course. As soon as the engineers had established grades on a street, the city's employees were set to work removing all loose material, tearing out cross-walks and other places that were high. The material thus obtained was used to regrade these places, any surplus being used to fill other low spots. All bad curbing was renewed or reset and all manhole covers brought to the proposed grade. The streets were scarified as little as possible, as it was believed that the old material, if left undisturbed, was far superior to any that could replace it. All places that had been fixed were wetted and thoroughly compacted with a 15-ton three-wheel Buffalo-Pitts roller. Where it was possible, the streets after being repaired were opened to traffic further to consolidate the macadam surface.



THE LIFE OF THESE RESURFACED STREETS IS ESTIMATED AT FROM 5 TO 15 YEARS

The hotstuff, as soon as it was mixed at the plant, was quickly conveyed to the streets in motor trucks. In cold and inclement weather all loads of binder and wearing surface were covered with canvas. On the street all the usual precautions were taken in the depositing, raking, and rolling the material. As a general practice, no larger area of binder course was laid than could be covered with one day's run of the plant on wearing surface. The asphalt surface was kept about ¼ in. high around all manhole covers and boxes, as well as along car tracks where they existed, and where no liners were used. Smoothing irons were used only where absolutely necessary, as it was believed to be better practice to let the traffic iron out the small irregularities that may appear in the finished surface.

REPORT FORM USED

The laying of the asphalt was supervised by two inspectors, one stationed at the asphalt plant and one on the street. Daily control of the sand was kept at the plant by screen analyses and penetration tests were made on all asphaltic cement used. Pat tests were made often and scale weights and temperatures were constantly checked. On the completion of every street the accompanying report was filled out by the plant inspector and kept on file as a permanent record:

BUREAU OF ENGINEERING
ROOM 18, CITY HALL
NEW HAVEN, CONNECTICUT

Season of............
SHEET ASPHALT PAVING REPORT FOR..............Street / Avenue
TRAFFIC { Heavy / Moderate / Light

Laid by ....
Inspectors ....Street ....Plant
Laid between ....
Foundation and condition...................................
Thickness of binder course.................................
Thickness of wearing surface...............................
Commenced laying.............Completed laying..............
Net number of working days.................................
Measured yardage laid......................................
Square yards laid per day..................................
Tons of binder used..
Kind of binder used..
Weight of binder per square yard........thick..............
Tons of extra binder used..................................
Tons of wearing surface used...............................
Weight of wearing surface per square yard......thick.......
Equivalent yardage ....
Average computed thickness W. S............................

ASPHALTIC CEMENT:
Kind ....
Manufactured by ....
How received ....
Fluxed.......... Kind............ Amount used..............
Penetration ....

BINDER COMPOSITION:
Mineral aggregate ....
Per cent of Asphaltic Cement...............................
Per cent of Mineral Aggregate..............................
Specific Gravity of Binder.................................

WEARING SURFACE:
Sand.................... Bank..............................

No. 200	No. 100	No. 80	No 50	No 40	No. 30	No. 20	No. 10	No. 8
—	—	—	—	—	—	—	—	—

Average Screenings ....
Filler ....Per cent passing No. 200 mesh............
Mix formula: %A.C......... %Filler........ %Sand........
Specific Gravity of Wearing Surface........................

REMARKS:
....
....
....

CONDITION OF PAVEMENT
End of 1st year..
" " 2nd " ....
" " 3rd " ....
" " 4th " ....
" " 5th " ....

Inasmuch as this resurfacing work differs from regular sheet asphalt paving construction only in the foundation, it is this part of the pavement that requires special attention. Precautions should be taken that all soft spots in the old macadam, new trenches, torn out cross-walks and gutters, areas around raised manhole covers, water and gas boxes are removed and replaced with thoroughly compacted material. Too much grading should not be done with the binder course, because this tends to produce excessive thickness of binder in certain places, which is not properly compressed even after the final rolling, and consequently leaves loose material to be beaten down by traffic later, resulting in the development of a depression in the pavement surface.

The surface of the binder course should be reasonably smooth and have the same relative crown and shape as that desired for the finished wearing surface. If this last condition is obtained, it is possible to lay the wearing surface course of uniform thickness, and thereby do away with thin places in the topping. When the time permits the street should be repaired and brought up to grade and opened to traffic for a couple of months before resurfacing. Any depressions that may develop in the street at the end of this time should be carefully repaired. This method of procedure will practically assure a thoroughly compacted foundation on which to resurface, and with proper precautions taken in the mixing and laying of the binder and wearing surface the work will result in a very stable pavement. This painstaking preparation of the foundation has been described fully, for it is of paramount importance if permanent pavements of this type are to be obtained. Many cities contain some very fine old Telford macadam pavements, compacted by years of traffic, and if properly treated they would be every bit as good foundations as could be laid.

COSTS AND SERVICE RECORDS

The average cost of all this work, exclusive of preparing the streets, was about 86 cents per square yard, the maximum price 91 cents per square yard, and the minimum price 77 cents per square yard. The variation in price was due to the varying amounts of binder needed over the specified 1½-in. course. The annual maintenance cost of keeping a waterbound macadam street in excellent condition is about 20 cents per square yard. If the resurfaced pavements therefore last only their 5-year guarantee period, their annual maintenance cost is no greater than that of a waterbound macadam street, and a wearing surface is maintained that is far superior from a sanitary standpoint.

Data of a conclusive nature regarding the service that may be expected of resurfaced streets under varying traffic conditions are not available, but the following account of work of this nature done in previous years in this city is of interest. In 1913 New Haven laid its first resurfaced street on old macadam, which consisted of about 5000 sq. yd. of surface. This pavement was guaranteed for only 1 year. The traffic on this street has been moderate. This pavement has been down now for more than 3 years and shows practically no greater signs of deterioration than would be expected of a similar pavement laid on a concrete base. In 1914 the city laid no resurfaced work. The year 1915 saw about 36,000 sq. yd. of old macadam resurfaced, all but 5000 sq. yd. of which were under a 5-year guarantee. The paved area of 1915 covered 17 different streets, and since that time they have been subjected for the most part to moderate traffic.

As the oldest pavement of this resurfaced type laid in New Haven is now in its fourth year of use, and looks practically as good as the day it was finished, the indications are that in this city, where there is a sand-and-gravel subsoil particularly favorable to this type of construction, the life of these asphalt-surfaced streets, unless local conditions or the volume of traffic is abnormal, will be from 5 to 15 years. Probably these older asphalt-surfaced streets have been down long enough to develop any faults that existed in the use of old macadam foundation, or in this general method of resurfacing. It is believed, in view of these results, that the pavements will give way eventually because of normal wear of the wearing surface, and that this will not be appreciably hastened on account of the old macadam foundations.

This work was all done by the Union Paving Company of Schenectady, N. Y., under the direction of the Bureau of Engineering of the city of New Haven. Frederick L. Ford is city engineer.

Second-Largest Concrete Building Erected

Two Units of Hoboken Water Terminal Containing 660,000 Square Feet of Floor Built Between June 6 and October 31 with One Set of Forms

WORKING SINGLE shift, without Sunday or holiday labor, and using but two mixers and a single set of forms above the first floor, the Turner Construction Company completed, between June 6 and Oct. 31 last, two units of a reinforced-concrete structure on the Hoboken waterfront of New York harbor containing 660,000 sq. ft. of slab, exclusive of the basement floor. A special set of panel forms was used for the basement walls and first-floor slab, which is of the mushroom type, but for all floors above the first, these being of beam and girder construction, a single set of forms sufficed. For a good portion of the time after the work was well under way progress averaged a floor a week. One entire floor containing 55,000 sq. ft. of slab was completed in 4½ days. Concreting progressed from the twin towers outward, the forms being removed below and re-erected above a few bays at a time. The buildings are almost entirely of concrete, no brick or flooring and very little tile being required. On this account, and because of the location at a rail-water terminal, the problem of delivering and handling materials was simplified.

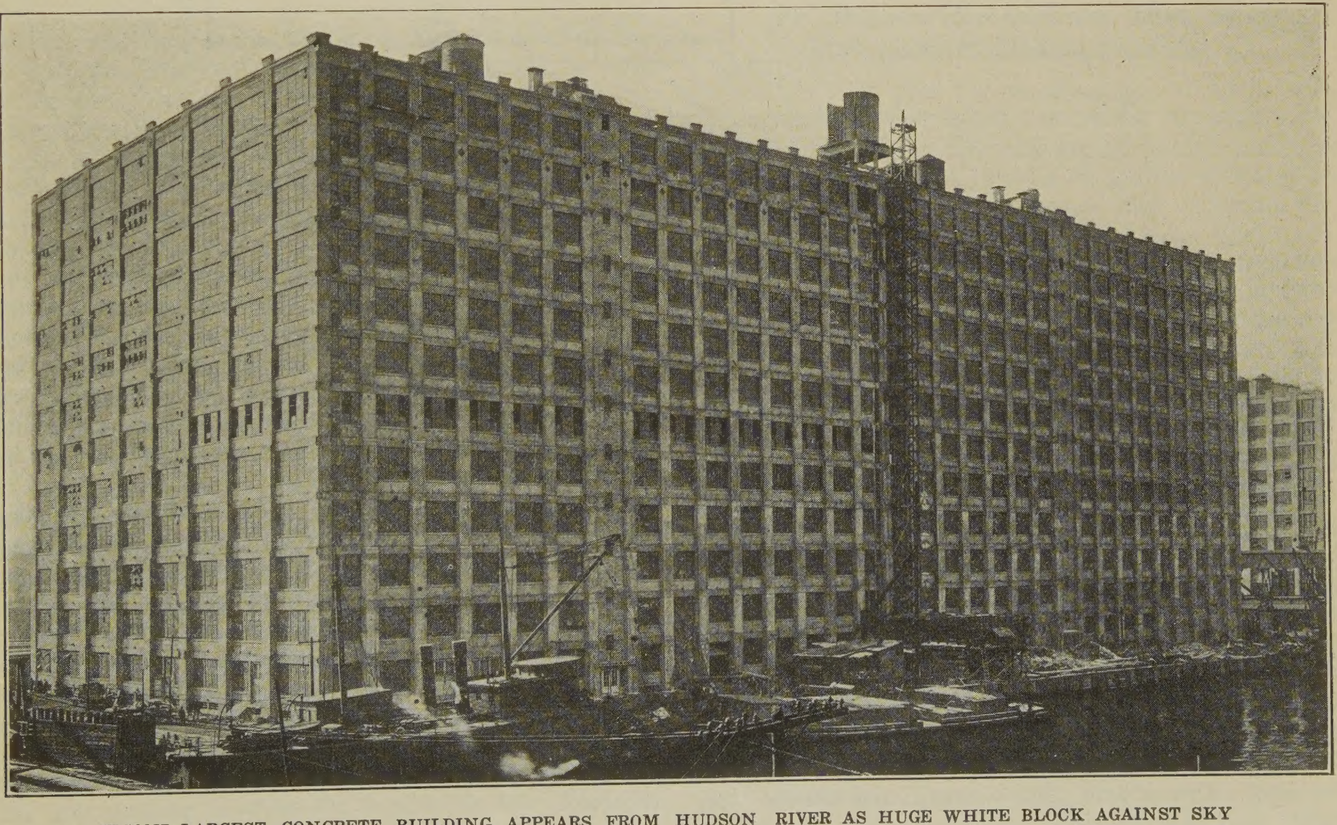
BUILDING ONE OF LARGEST IN COUNTRY

The building is located above Fourteenth Street and in line with Washington Street in Hoboken, N. J., on the south side of a slip leading to the Hudson River just north of the Fourteenth Street (Hoboken) ferry house. When completed it will be in the shape of a U, with the long axis parallel to the slip. The building will be divided by concrete fire walls into four independent sections, each rented to a different tenant. Two of these sections, comprising half of the base and all of that leg of the U next the slip, compose the structure which was completed within the time mentioned. The first portion of the building to be constructed adjoins the east end of the part just completed and forms the south part of the base of the U and the east part of its southern leg. This structure, built by the same contractor, was completed between June 4 and Sept. 15, 1915.

The portion of the structure at present completed, comprising these three units, is said to form the second largest reinforced-concrete building yet erected, being exceeded only by one of the Bush Terminal buildings in Brooklyn, N. Y.

UNUSUAL STORY HEIGHT ADOPTED

The three units, taken together on the basis of cubic contents, perhaps form one of the largest buildings in the country because of the unusual story height of 14 ft. 6 in. This story height was selected because the owners were desirous of having an exceptionally well-lighted structure. Moreover, the building will be occupied by manufacturing concerns using a great deal of overhead shafting for the transmission of power. Provision for securing the hangers for this shafting to the floorbeams was made during the construction of the building by placing short lengths of ¾-in. pipe across the beam boxes at the proper intervals and con-

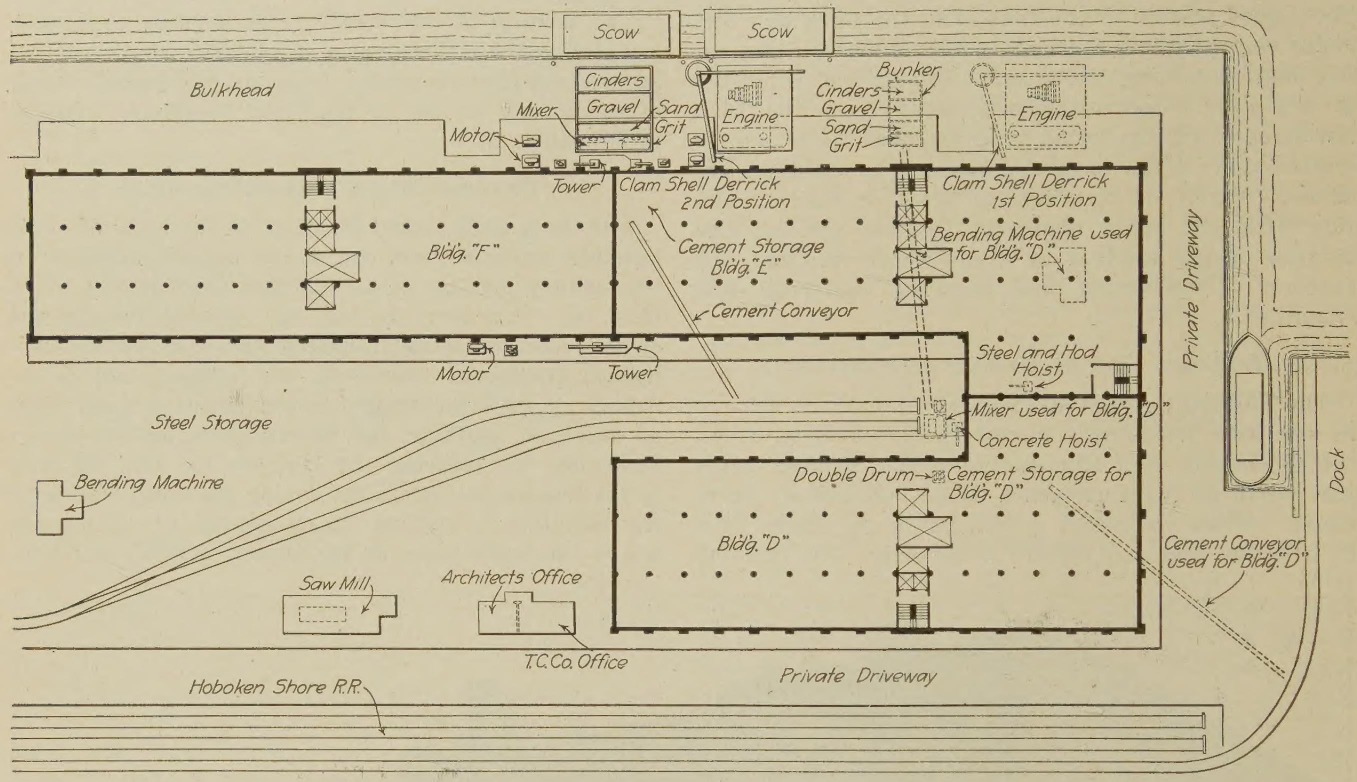


SECOND-LARGEST CONCRETE BUILDING APPEARS FROM HUDSON RIVER AS HUGE WHITE BLOCK AGAINST SKY creting them in. These pipes were inserted at such a height as to bring them about 2 in. below the finished ceiling. A bolt is passed through each pipe which clamps a pair of hangers, one on each side of the beam.

The exterior walls, all the stairways and the skylight framing are of reinforced concrete. The stair wells are surrounded by partitions of hollow tile. The fire walls between sections of the building, however, are of concrete. The windows are of steel sash, glazed with wire glass.

ONE DERRICK FOR TWO CONCRETE PLANTS

The building is founded on wood piles averaging 40 ft. in length. Those for the section erected in 1915, known as building D, were driven during the spring of that year. Those for sections E and F, erected last summer, were driven at the convenience of the contractor, after the completion of building D and before the beginning of warm weather last spring. Most of this work was done with land drivers, only a few rows of piles next the slip, which support the new dock, requiring the use of a floating machine.



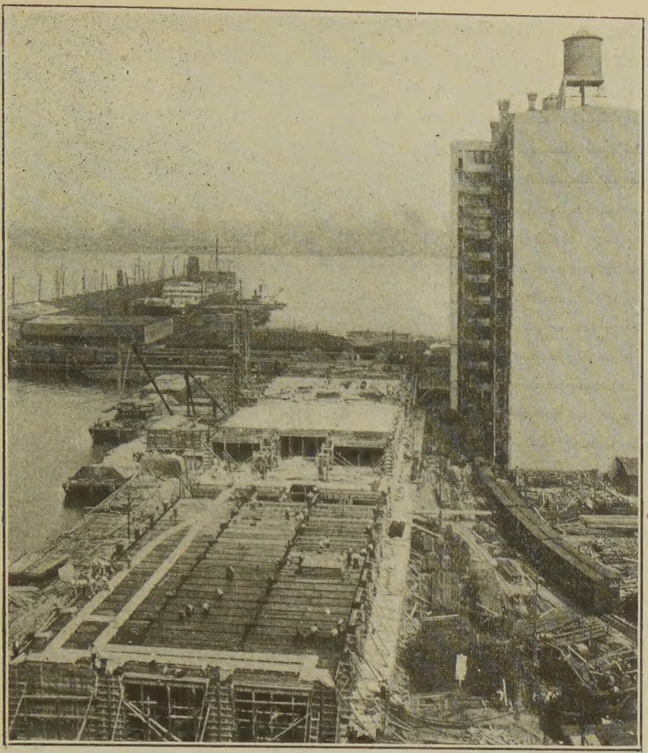
DOUBLE CONCRETE PLANT, SERVED BY ONE DERRICK, POURED 800 YARDS A DAY

In constructing section D a single concrete mixer and tower located on the north side of the building had been used. This plant was supplied with aggregate by a pair of cars running on a double narrow-gage track to hoppers set on the south side of the slip. The cars were operated by a hoisting engine and the bins filled with material from barges by a derrick and grab bucket. During the winter this plant was moved west to a location on the slip and another mixer and hoisting tower were added to it. In its new position the enlarged plant was symmetrical about the center line of the fire wall separating the units E and F of the building. One 1½-yd. Smith mixer and one hoisting tower were thus provided for each section. As will be seen from the layout drawing, the towers were directly south of the new bins in this location. The tracks for the swivel dump cars which supplied the mixers were thus very short and the cars could be operated by hand. By securing a thoroughly competent hoisting engineer, the one derrick with a 1½-yd. bucket was able to supply the bins with sufficient material to keep both mixers in operation, though each plant alone frequently poured 400 yd. a day. The operation of the concrete mixers was organized so that there was always one batch in the mixer while a skip of concrete was being hoisted in the tower, one dry batch in the charging hopper of the mixer and one dry batch being drawn into the small car from gates under the material bins.

Piles, reinforcing steel and cement were delivered to the work by rail on sidings located inside the area bounded by the U. A line of gravity rollers was installed from the nearest of these sidings through the building alongside the fire wall above the first-floor level to a point opposite the mixers at the level of the charging platforms. Cement was unloaded from box cars in this way and conveyed to the mixers. In addition, a storage capacity of several cars was provided in building E at the first-floor level.

The reinforcing steel was bent and stored on the south side of the buildings. An additional tower was located near the center of the south side of the section. On the corners of this were mounted two booms used to hoist the reinforcing to the desired floor. The tower also contained a cage large enough to hold two buggies. This cage was used to hoist the tile. The men, however, used the stairways throughout the job in spite of the unusual height, a total climb of more than 190 ft. from the ground being necessary to reach the roof.

Work on the concrete forms began with a full force



IMMENSE STRUCTURE CARRIED UP WITH ONE SET OF FORMS

of carpenters about a month before time for concreting. All the forms were of wood except the Blaw forms for the round interior columns. The flat-slab forms for the first-floor and basement walls were completed first, and while these were being poured the single set of forms provided for all floors above the first was finished. A circular motor-driven saw was used in this work.

It was unnecessary to provide more than one set of forms in order to keep the mixers running continuously on account of the large floor area involved. Before the last of one floor had been finished, it would be safe to remove forms from the first portion poured. The forms were raised and re-erected in irregular-shaped units, which, however, were the same shape and location throughout, and which averaged about nine bays in area. Each floor was begun by pouring the unit adjoining the hoisting tower, beginning at the further edges of the unit and taking up the runways for the concrete buggies toward the tower as the work progressed. Next day, when the adjoining section of form was ready, these runways would be replaced on top of the finished section. Work progressed in this way until the far corner of the floor, diagonally opposite the tower, was reached. About 14 wheelers were required in starting a floor. To maintain the same rate of progress as the work reached the far edges of the floor it was necessary to increase the number until 18 buggies were in service.

STAIRS CONCRETED SEPARATELY

As the work progressed it was necessary to piece out the form panels on account of the decreasing size of columns and beams. Section E has been leased for a long term to a tenant who will have very light loads on the seventh, eighth and ninth floors. The form panels for this building between the floorbeams had to be considerably enlarged on reaching these floors, and had to be cut down again for the tenth floor.

Practically the only formwork left behind as the main floors were carried up was that for the stairs, of which there are two sets in each section. These were formed and poured one or two floors below the main work. As the concrete towers were carried up, a hopper was left at each floor level into which concrete could be dumped at will by setting the trip at that floor. It was thus possible to deliver concrete at any level for finishing stairs or other small jobs.

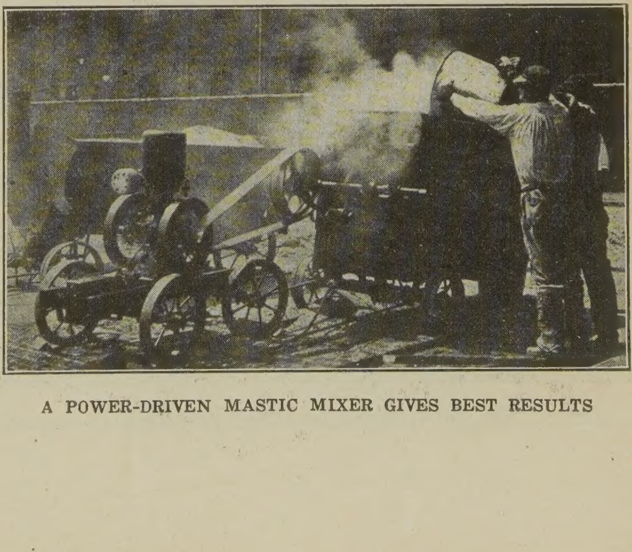
Tile partitions around one stair well and around the freight and passenger elevator shafts subdivide each unit into separate halves to reduce the fire hazard. Except for these, all of the floors are open full length and width. On this account, the trim furnished under the general contract was a small quantity compared to the size of the building. All machinery, except that for the heating and lighting plant of the building, is installed by the tenants. The piping and conduits for the steam heat and lighting wires were carried up by the contractor as the forms were stripped from each floor. The pipe was raised to the proper floors by hand with light tackle.

The daily force employed on the building included 78 carpenters, 325 laborers and 14 to 16 lathers, who placed the reinforcing steel in the forms. The building has been constructed for the Hoboken Land & Improvement Company under the direction of Charles Fall, architect, by the Turner Construction Company. The construction has been in charge of Albert Larsen as superintendent.

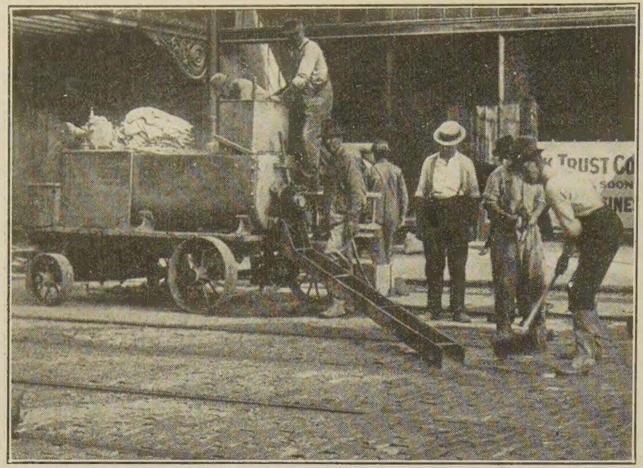
Machine-Mixed Filler Best for Granite-Block Pavement Joints

Greater Economy and More Perfect Results May Be Obtained Mechanically Than by Time-Honored Manual Methods

SCARCITY of labor during the last year and a half has forced engineers and contractors to resort more generally to mechanical methods of filling joints in granite-block pavement instead of the old practice of hand pouring. Recent tendencies also point to the elimination of gravel and pea stone in the joints and the use of asphalt or tar-sand mastic and straight 1:1 cement-sand grout. These are some of the changes in practice which have been observed by Zenas W. Carter, field secretary of the Granite Block Manufacturers' As-



A POWER-DRIVEN MASTIC MIXER GIVES BEST RESULTS



SPECIAL MIXER FOR GROUT GETS RESULTS AND SAVES LABOR

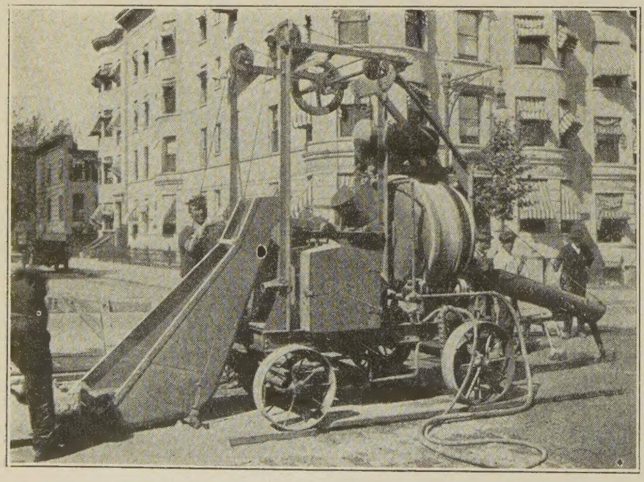
sociation, from whom this journal has received the information upon which the following notes are based:

Mechanical Methods Gaining Preference

The mechanical mixing of concrete for street foundation is now a feature of many modern specifications, and tendencies indicate that the better quality of concrete so produced will find a reflection in a demand for machine-mixed grout and bituminous fillers as soon as a machine for this purpose has been developed to a point where it will be dependable and economical. Experience shows that the conventional drum mixer can be used without trouble and with many advantages in preparing and depositing cement-sand grout. Not only is there a labor saving in men, but the fatiguing work of the box and hoe method is eliminated.

With bituminous fillers the advantages should prove to be even greater. The heavy, resisting nature of even heated asphalt and tars is increased by the addition of sand, the result being quickly tiring muscles and a disposition on the part of the men to diminish the sand percentage and to slight the mixing. It is hardly necessary to mention the effect of an inadequate distribution of sand through the bitumen, but it is not so generally recognized that too rich a mastic cannot give the necessary support to the edges of the block and will, furthermore, produce a sticky, impassable pavement.

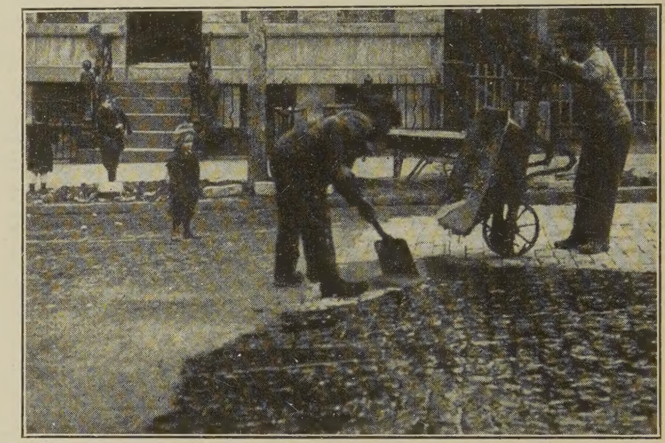
The introduction of modern methods is being aided by the growing demand for more perfectly cut granite blocks. The newer specifications are responsible for so perfect a cutting that the brooming of gravel and pea stone into the joints is impossible. The older practice made this step necessary, since the interblock spaces were so large that a mastic which could be placed would not remain placed unless more or less supported by a larger aggregate.



USE YOUR CONCRETE MIXER FOR GROUT

At first the method of adding the heated sand to the hot bitumen was very crude. The bitumen was drawn into the hand-pouring kettle, a shovelful or more of heated sand was dumped into the kettle and the pourer then stirred it together before pouring it into the joints. In some of the work in Brooklyn and in Cleveland the mastic filler was mixed in special heated tanks, into which the heated bitumen and heated sand were poured separately and then thoroughly mixed by means of a screw or fan blade on a shaft rotated by a handcrank outside the tank. The filler was then drawn off and poured from standard pouring kettles.

Recently, however, in Brooklyn, there has come into use a truly mechanical mixing of this asphalt or tar-sand mastic filler. The illustration shows a fan-bladed shaft-tank mixer into which the heated asphalt and heated sand are dumped and the mastic thus made is drawn off into huge carrying tubs or heated steel wheelbarrows. Dumping instead of pouring gives the best results in mild or warm weather, when the blocks are thoroughly dry and warm.

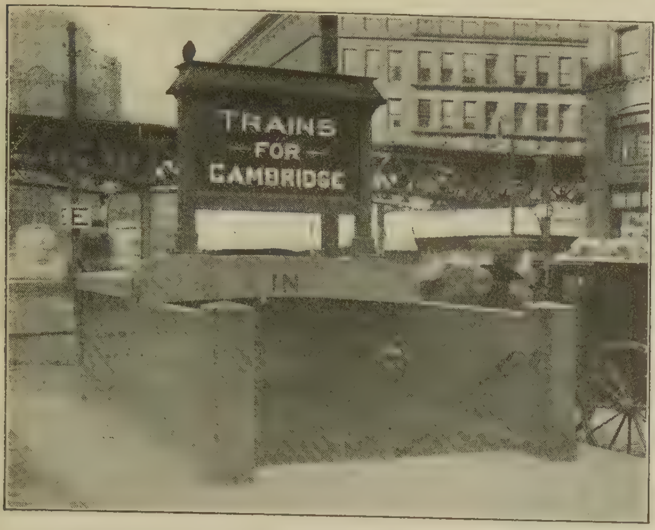


MASTIC SPREADS EASILY AND GIVES BITUMINOUS MAT

Contractors using these simpler and quicker methods of handling the mixing and distribution of the mastic and grout fillers report savings in labor amounting to from 25 to 40 per cent.

Cement Production for 1916

According to figures furnished by the Portland Cement Association the cement production for 1916 was 91,333,000 bbl., while shipments were 94,522,000 bbl. These figures are based on actual returns from 105 plants and on estimates for some other plants which do not report. Compared with these figures are those recently sent out by the United States Geological Survey, which give a production of 91,194,000 bbl. and shipments of 94,508,000 bbl. Although the production during 1916 is slightly below the previous high record of 1913, the shipments reported for the past year hold the record.



STAIRWAY COVERING AT ENTRANCE, SOUTH STATION UNDER

Polished Concrete in Surface Structures of Boston Subways

Stairway and Escalator Coverings Have Special Architectural Features—Granite Concrete Mixture Described and Costs Given

By LAURENCE M. MANLEY
Assistant Engineer, Boston Transit Commission, Boston

OVER the stairways and escalators of the newest Boston tunnel stations, shelters of masonry with polished granite walls and ornamental concrete roofs have been constructed which combine in a harmonious manner the advantages of both materials. These structures have been built by the Boston Transit Commission in connection with the finish of the stations of the East Boston tunnel extension in Scollay and Bowdoin Squares and of the Dorchester tunnel in Dewey Square. The latter, called "South Station Under," was described by W. W. Lewis in the Engineering Record of Dec. 30, 1916, page 800. They are of two types, a low, half-covered shelter over the fixed stairs and a higher and more ornamental structure which completely covers the machinery and upper landing of the moving stairs.

Stairway Coverings

The coverings over the stairways consist of a parapet wall 3 ft. 3 in. high, of polished dark Quincy granite, set on a low coping of concrete and roofed over for about half of its length with a slightly arched slab of reinforced concrete, the dark surface of which is rubbed smooth to reveal the granite aggregate. At its forward end the top of the roof is raised to form the support of the copper-covered frame of the destination sign, made of wood, which is illuminated from above by ten incandescent lights placed under its overhanging roof.

The parapet wall extends 18 in. beyond the top riser of the stairs to allow for handrail connections, and terminates in a granite post 11 x 13 in. in section, set about 2 ft. into the concrete for the lateral support of the unroofed portion of the walls. The slabs are 7 in. thick and are given a high polish on all exposed surfaces. The whole structure is 15 ft. 2 in. long and 4 ft. 6 in. high at the crown of the arched portion of the roof.

The stairs are of precast reinforced-concrete units with 7 in. risers and 11 in. treads, and are provided with grooves along the back and across the ends of each tread to lead rain water to the sumps at the landings. The granolithic coping, finished like the stairs, rises 6 in. above the sidewalk and shows on the inside for a depth of 15 in. Below the coping, as far as the second landing, the walls are finished with granite terrazzo, which is easily kept clean and is little affected by driving rain or frost. For stairways of the usual width of 8 ft. two side rails and one center handrail are provided.

Escalator Headhouse

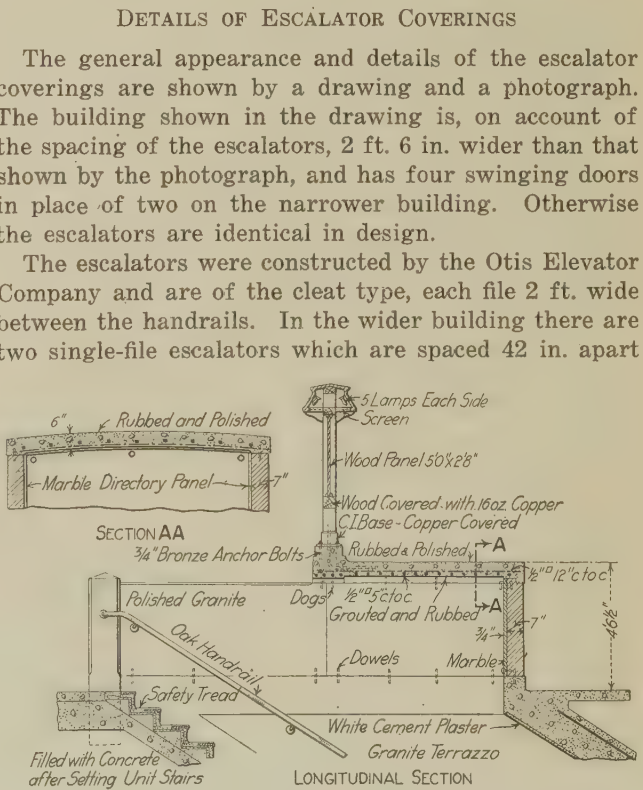
The buildings over the escalators are also constructed of polished granite and concrete and are like those over the fixed stairs, but are enlarged and extended to shelter the moving stairs. The rear portion of these buildings is of the same height and shape as those over the stairways, but in place of the open well hole the upper part of the escalators is covered by a sloping roof and the landing at the street level is housed in by a headhouse 10 ft. high, which extends 4 ft. in advance of the handrails. The granite walls of this headhouse are 10 in. thick and extend to the elevation of the top of the sloping roof, 6 ft. 1 in. above the landing. Above this level the walls are of concrete, the surface of which is broken up into moldings, sunken panels and an elaborate cornice around the eaves of the arched roof.

Over the entrance an elliptical arch springs from the top of the granite walls and the opening below is closed in by a glazed transom and swinging copper-covered doors. At the Scollay Square escalator the full opening is available through four doors, but on later constructions at Dewey Square a fixed center panel is provided, behind which a heated shelter for the attendant may be placed.

Details of Escalator Coverings

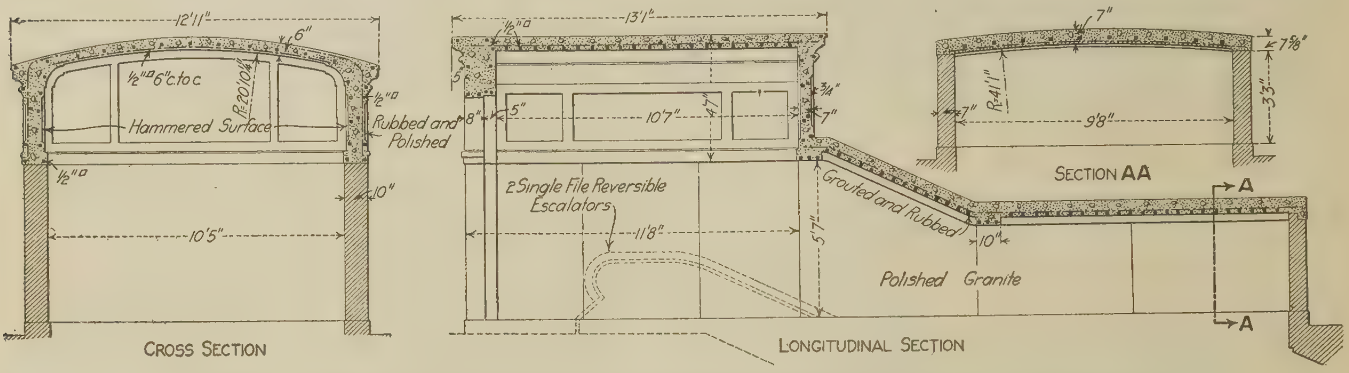
The general appearance and details of the escalator coverings are shown by a drawing and a photograph. The building shown in the drawing is, on account of the spacing of the escalators, 2 ft. 6 in. wider than that shown by the photograph, and has four swinging doors in place of two on the narrower building. Otherwise the escalators are identical in design.

The escalators were constructed by the Otis Elevator Company and are of the cleat type, each file 2 ft. wide between the handrails. In the wider building there are two single-file escalators which are spaced 42 in. apart



DETAILS OF STAIRWAY COVERING, SHOWING MATERIALS USED between handrails to prevent interference between passengers when the files are moving in opposite directions. In the narrower buildings, where both files move upward, the spacing is 9 in. The escalator from the lower platform of the South Station Under to Dewey Square at Federal Street has a vertical lift of 43 ft. 9 in. and a total length of 103.5 ft.

For practical reasons the roofs of the structures under discussion are constructed of concrete, and much care has been exercised to produce surfaces which would form an agreeable contrast to the polished granite upon which they rest. The main body of the concrete is of the ordinary 1:2:4 mixture, with a veneer of granite mixture cast at the same operation on the exposed faces. The exterior surfaces are rubbed and polished and a portion of the interior surfaces are patent hammered.



DETAILS OF HEADHOUSE FOR ESCALATORS—POLISHED GRANITE WALLS AND CONCRETE ROOF

The concrete was mixed and placed by the commission's force of skilled laborers assisted by a terrazzo worker. A layer of granite mixture 1 in. thick was first spread on the forms and carefully compacted. The steel reinforcement was then set and the interior concrete, mixed as wet as possible, was placed, the granite being carried up on the edges. Vertical walls were cast solid of the granite mixture, which was carefully placed with trowels, no spading against the forms being permitted. All the operations were carried on so as to keep the maximum amount of aggregate at the surface. On the top of the roofs a 1-in. layer of granite mixture was spread and screeded, dry cement was added to stiffen the mixture and additional granite spread over the surface and rolled and troweled into place.

Proportions of Granite Mixture

The proportions of the granite mixture were as follows: Cement, dark Hudson River Atlas and Alpha, 4 bags; crushed dark Quincy granite, ⅛ to ⅜ in., 8 bags; lampblack, Germantown, screened with the cement, ½ to 1 lb. The smaller amount of lampblack gave the best results on the hammered work and the larger amount the best on the rubbed work. The most satisfactory granite aggregate was obtained from the same quarry from which the parapet slabs were taken. It was crushed with considerable difficulty in a small terrazzo crusher at a cost of about $17 per ton. The crushed granite contained about 42 per cent voids.

The outside forms were made of cypress in a woodworking mill. The cost, including spruce ribs for the support of roof forms, was $24 for stairway coverings and $160 for those over the escalators. One set of the latter forms have been used three times and are stored for further use.

The inside forms were constructed of plaster about ¾ in. thick applied on wire netting fastened over rough wooden lagging. Portland-cement plaster was used for forms on the first buildings constructed, and on some of the later work plaster of paris mixed with a small quantity of lime was substituted. On account of the rapidity of its set, the plaster-of-paris forms were made more quickly than those of Portland cement, but the resulting concrete did not seem to justify the use of this material. The plaster seemed to soften and break up while the concrete was being placed, and notwithstanding its two coats of shellac, considerable trouble was experienced in removing it from the finished concrete.

The use of plaster forms was suggested by the satisfactory results obtained from forms of the same material for casting thin, segmental slabs of white cement 5 ft. long by 2.5 ft. wide which were set between roof beams at one of the tunnel stations to hide an unsightly space above. Both wood and metal-covered forms failed to produce the smooth, unmarked concrete surface required, and the wooden forms were finally covered with a layer of Portland-cement plaster ¾ in. thick, troweled smooth. The plaster forms were coated with Minwax clear waterproofing and soap powder, and the white cement slabs cast upon them were removed without difficulty after a set of two days. These slabs were put in place without any further treatment and at a short distance cannot be distinguished from the white plaster adjoining.

Use of Plaster Forms Satisfactory

The results from the use of plaster forms on the work under discussion were very satisfactory, except that in some cases difficulty was experienced in removing the plaster from the concrete. It is probable that the trouble was caused by the ramming of the concrete while it was being placed, which caused the particles of stone to cut into the plaster forms with a resulting bond between the two. The greatest difficulty was experienced with the soft plaster-of-paris forms, while the hard and well-seasoned forms of cement were removed with little trouble. The resulting concrete surfaces were practically as smooth as plaster without the danger of peeling inherent in plaster in such exposed locations. The gain over wood forms in smoothness of surface, watertightness and freedom from warping was made, however, at a considerable added expense on account of the high price of plasterers' labor.

The outside surface of all the concrete has been rubbed and polished, the inside surface grouted and rubbed except at the upper walls and roof of the escalator headhouses, which are patent-hammered. The hammered work was six cut on the panels and eight cut on the pilasters and moldings, and in appearance closely resembled cut granite.

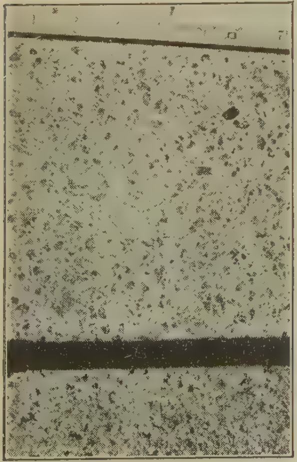
The rubbed surfaces were also hammered roughly as a preliminary treatment and the arrises were made straight and sharp by chiseling. On the first coverings constructed, this hammering was omitted and it was found that, during the laborious work of rubbing about ⅛ in. from the surface of the concrete, straight lines became wavy, curves became uneven, and hollows appeared in plane surfaces in spots convenient to rub. The preliminary hammering and chiseling rectified many minor irregularities in the lines of the structure and, by reducing the amount of rubbing, preserved these lines and lessened the cost of this portion of the finish.

COST OF COVERINGS OVER STAIRWAYS AND ESCALATORS IN DEWEY SQUARE, CONSTRUCTED IN 1916

	Buildings over escalators, average of two	Buildings over stairways, average of four
Wooden forms (used 3 times)	$65.00	approx. $10.00
Erecting forms	190.00	31.45
Plastering forms	180.56	15.35
Stripping forms	36.93	17.15
Concrete, labor	146.50	52.00
Concrete, materials	163.72	25.71
Hammering	254.91	32.52
Rubbing	251.98	68.59
Polished granite	1,120.00	490.00
Copper-covered doors	233.00	.....
Copper-covered signs	.....	105.00
Total	$2.642.60	$847.77

Engineering and overhead expense not included.

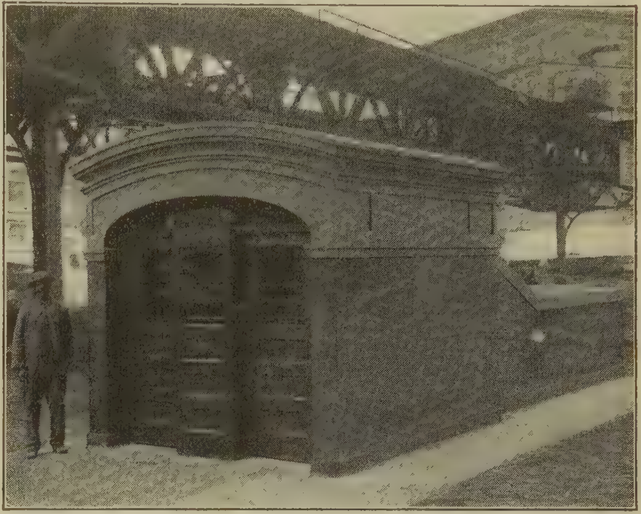
The first rubbing was made with a coarse carborundum brick (No. 60) fastened to a wooden handle about 3 ft. long, and was continued until the marks of the hammer were removed and the granite aggregate was revealed. The removal of the outside skin of cement by hammering and rubbing exposed the imperfections in the structure of the concrete, and numerous small voids caused by excess water, entrained air, and by bits of granite pulled out of the concrete by rubbing were disclosed. After this rubbing, the concrete was thoroughly cleaned, first with diluted acid and finally with a stream of water from a hose, and the surface was grouted with neat cement darkened with lampblack and well rubbed in. The grout was allowed to set under damp cloths for one day, and in the open with frequent sprinklings for about one week.


POLISHED CONCRETE ABOVE —POLISHED GRANITE BELOW

The surface was then given successive rubbings with three finer grades of carborundum bricks and was finally polished with a hone stone and polishing putty. This treatment gave a high polish to the granite aggregate showing on about 60 per cent of the surface and smoothed the cement to as near a polish as it would take. The "close up" photograph shows the appearance of some of the best of the finished surface.

This surface is obviously that of an artificial product, not to be compared with the granite cast in Nature's mold. It is, notwithstanding, dense, weather-resisting and clean and affords a contrast to the rest of the structure which is not unpleasing.

A table of costs is given herewith. The polished granite and the doors and signs were furnished and erected by contract, the mixing and placing of the concrete were done by the commission's day-labor force and the remainder of the work was done by skilled mechanics at cost plus 10 per cent and insurance from contractors doing work on other portions of the station.


COVERING FOR DOUBLE-FILE ESCALATOR, SOUTH STATION UNDER

The cost of the preliminary hammering of the outside of the escalator coverings, including the chiseling of the arrises (790 ft. in length), was 42½ cents per square foot of developed surface. Deducting 12 cents per linear foot for chiseling arrises, the net cost of the hammering was 13 cents per square foot. The cost of hammering the inside surfaces, mostly ceilings, with six and eight-cut work was 46 cents per square foot, or after making the same deduction for chiseling corners, 27 cents per square foot.

The rates paid for labor were as follows:

	Cents per hour
Carpenters	40 and 50
Stonecutters	65 and 70
Terrazzo mechanics	53⅛
Terrazzo rubbers	33¾
Plasterers	70
Plasterers' helpers	45
Laborers	28⅛ and 31¼

The scheme of the stairway and escalator coverings described in the foregoing was adapted in the office of the Boston Transit Commission, of which Edmund S. Davis is chief engineer, from designs furnished by A. A. Shurtleff, landscape architect, in consultation with George Lawrence Smith, architect. The construction as a part of the finish of the tunnel stations was under the supervision of the writer.

EVEN IN ROCK THE WATER MUST BE TAKEN CARE OF BY DITCHING

Heavy Trucks and High-Material Prices Affect Massachusetts Road Work in 1916

With Wages High and Labor Scarce the Highway Commission Was Unable to Complete Contemplated Program, According to Annual Report

IN the face of the unusual conditions obtaining during 1916, the annual report of the Massachusetts Highway Commission, from an advance copy of which the following notes have been taken, shows that existing roads have been maintained in fair condition, new construction completed over a satisfactory mileage, and a general advance gained in the knowledge and use of the newer road materials. The report suggests certain additional legislation, chiefly that new and equitable sources of revenue from motor traffic and benefited communities be uncovered and made available for maintenance and reconstruction.

WOULD REGULATE HEAVY TRUCKS

Stronger and more expensive road construction is necessitated by the increase in traffic, and especially by the weight of traffic. Most of the bridges were built when the heaviest load anticipated was a farm wagon carrying 3 tons. In the opinion of the commission, the users of such vehicles as a 6-ton motor truck carrying a 7-ton load neither make nor save enough money to justify the damage caused by them. In one day these trucks often ruin enough road or damage bridges to an extent that will more than offset the whole value of the truck and its potential work. Few of the towns can afford to reconstruct their roads for such heavy units. Six or seven years ago no state highway was made strong enough to withstand this traffic and few are so built to-day. The commission believes that, at the most, not over 6 tons gross should be permitted to be moved over country and village roads or bridges. Even on city pavements a lower limit than the present 14-ton maximum appears desirable. Effective regulation should make the vehicle owner responsible for all damage caused to bridge or road, and the sum recovered used for reconstruction.

The demand for unskilled labor and the high wages paid by factories last year, combined with the return of reservists to Europe, not only increased wages but led to a scarcity of labor in many places. Advertised bids of the board were 50 to 100 per cent higher than ever before. In several cases the commission did not award the contract. If conditions do not improve much larger appropriations must be made for reconstruction and widening of the old state highways, or they will be rapidly destroyed.

The construction of new highways will call for more money per mile, not only on account of advanced prices, but because, with traffic increase, they must be made wider and stronger. Either a shorter length must be constructed each year or more money be made available.

The commission has been unable to determine this differential and when, as a result, it should refrain from building. Since it is impossible to judge how long the present conditions will continue, the commission followed a middle course, letting contracts when the bids were only 40 to 50 per cent above 1915 prices, and delaying the work when the bids seemed excessive and the importance of the road did not justify the expenditure.

NEW CONDITIONS AFFECT CONTRACTS LET IN 1915

In 1915 the commission prepared specifications and let contracts for long stretches of average construction and a number of miles of expensive road. Also contracts were let for shorter stretches of road where the construction costs were very high, due to the large quantities of materials that had to be handled. Many of these contracts were let at extremely low prices, even for 1915. At that time $2 was probably the prevailing price for 8 hours' work.

On all these contracts a large amount of work remained to be done in 1916. Early in the spring of 1916 it was difficult to secure laborers at $2.40 a day, and in many places later in the year $3 a day was paid. Even then it was difficult to secure and keep enough laborers to prosecute the work economically or expeditiously. Many contractors were losing large amounts of money and both they and the commission were dissatisfied.

On account of these conditions the commission was convinced that it should be as liberal as possible with all contractors showing a reasonable disposition to push the work, and that it was not fair to extend the contracts at the existing prices. The commission felt, however, that it had no right to cancel contracts already in force, merely because wages had gone up, but rather that it should make all possible allowances. In some cases in order to get the road completed it seemed wise to extend the work and estimate it either as extra work under the contract or allow what the engineers considered a fair price on account of the increased cost of materials and labor.

At several times during the year the railroad embargoes on road materials delayed work, and at no time were the local quarries able to produce as much broken stone as was needed for road construction.

ROADS WIDENED TO 18 FEET

Both in new construction and in resurfacing main lines of traffic the hardened surface has been widened from 15 ft., the standard of a few years ago, to a minimum of 18 ft. on the straightaway and 21 ft. or more on the curves. All curves have been banked, where possible, with a pitch of from $\frac{3}{8}$ to $\frac{3}{4}$ in. per foot of width. Shoulders 3 ft. wide are standard and less crown is built up than formerly.

On many main lines where the road has been resurfaced it has been necessary, because of the heavy motor traffic, to put in a new foundation, although the old construction had lasted 10 or more years under previously prevailing traffic. In the construction of all main lines the design has been strengthened. All conditions have conspired to increase construction, reconstruction and maintenance costs.

On Cape Cod, where the traffic is usually light in weight, though dense, the commission has continued to construct roads made of sand, heated and mixed with a hot asphaltic oil. Some of these roads, built six or more years ago, are still in a satisfactory condition. The same construction has been used both for widening old macadam road and for a 2-in. wearing surface.

SCARIFIER THAT PROVED EFFECTIVE ON MASSACHUSETTS ROAD WORK

DARK AREA SHOWS MOISTURE DUE TO LACK OF PROPER DRAINAGE

On roads where heavy traffic was anticipated, both the penetration and mixing specifications were used. On grades the commission has continued in many places to grout the top course of 3-in. stone with a hot mixture of tar and sand, leaving the surface rough, hoping that it will prove less slippery for horses. In some places the bituminous surface cost has been omitted for this reason. While this may help for a time, the commission fears that the road surface will eventually ravel or disintegrate due to the penetration and freezing of water.

CONCRETE RECEIVES ATTENTION

On main lines the commission has more and more each year favored the building of cement concrete roads, noting the increased mileage and satisfactory service of this type of construction in the West and in New York and Connecticut. The commission has not felt, however, that even on main lines it should substitute cement concrete for all other forms of construction. It has built a good many miles of concrete roads and is building more yearly where the traffic is likely to be heavy and where the road can be closed absolutely during construction. In reconstructing the older state highways where a new foundation is found necessary, it frequently seemed advisable to substitute a concrete road, but where 2 or 3 in. of the old road remains well compacted, and not broken through, it has proved more economical to use the old roadbed as a base and resurface with some form of bituminous top.

All concrete roads have been made at least 18 ft. wide, and extreme care has been taken to provide for adequate drainage and foundation. Usually a 1:1½:3 mix is used, though occasionally a 1:2:4. All sections are at least 5 in. thick at the sides and 7 in. thick in the center. Where conditions are not of the best, these dimensions are increased by an inch. For the last two years hydrated lime has been incorporated in all concrete. The specifications call for materials of the highest grade and the commission feels that its inspection is adequate.

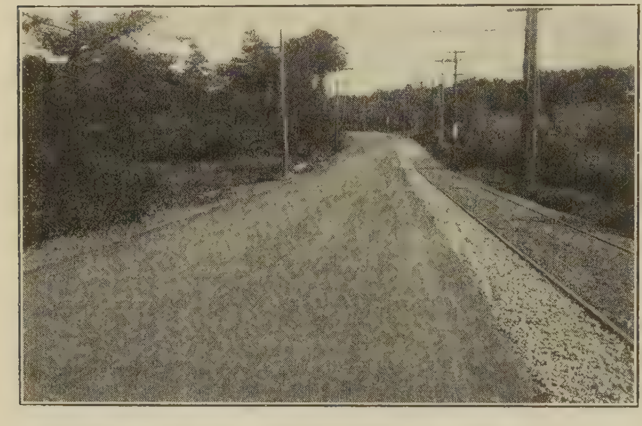
MAIN ROADS WIDENED AND IMPROVED

While building stronger and more expensive roads where traffic is heavy the policy of the commission has been to attempt to get the main routes widened and improved so that they can be used in safety and comfort at least during the summer. In the western portion of the state, where the traffic is light and mainly motor driven, this has constituted the main part of the work.

During the year ended Nov. 30, 1916, the commission completed work on about 31 miles of state highway. Construction was begun, but not completed, on over 17 miles of roads in 18 municipalities. Layouts were made of 54.47 miles of state highway in 39 cities and towns.

MUNICIPALITIES AND COUNTIES CO-OPERATE

Particularly during the last two years the counties and municipalities have co-operated and built connecting roads, or made appropriations to aid in improving the main routes. Appropriations two or three times larger than those of former years are now common and nearly one-half of all the municipalities have made appropriations for the purpose of improving through routes. The commission hopes that the time will come when the counties will appropriate enough money to match all the motor vehicle fees that are available for co-operative construction.



A STRETCH OF GRAVEL AND ASPHALT SURFACING

Requests of municipal authorities for engineering advice are numerous and in all cases the commission sends an engineer to look over the ground. Under certain conditions the commission furnishes plans and specifications, advertises the contract, and arranges for the supervision of the work. Almost invariably the advice of the commission and its engineers is followed by the local authorities. In this manner engineering advice was furnished forty-three municipalities in 1916. The law now requires that specifications for the construction of municipal ways be approved by the commission before the municipality can borrow long-term money for the work. Under this statute eighteen municipalities presented specifications for approval in 1916.

ROAD CONSTRUCTED BY CONVICT LABOR

In 1915 convict labor was used in improving the highway from Princeton Village to the foot of Mt. Wachusett. About forty convicts were maintained at the camp, an average number of twenty-six being used on the road. In five months this gang built 7500 ft. of macadam road 14 ft. wide at a cost of $5,175. The macadam was compacted with a horse roller to a thickness of 8 in. at the center, tapering to 6 in. at the sides. The county was allowed $1 per day for each convict furnished. Foremen received $2.50 per day. No overhead charges were figured in the above cost. This work was continued in 1916, appropriations totaling $7,000 being available. Within a limited field the commission finds such work desirable.

RESURFACING AND WIDENING

About $1,415,000 was available in 1916 for maintenance, widening and resurfacing. The report of the commission states that as much again could be expended with good results.

Over 3,800,000 gal. of various tar and asphalt products were used in construction and for surface treatment and patching. During the year 51.5 miles of state highway were resurfaced and 23.5 miles were widened but not resurfaced. Forty miles were widened and resurfaced at a cost of over $657,000, of which widening alone absorbed over $156,000. The resurfacing, therefore, cost nearly $10,000 per mile. This large expenditure was due to the high cost of labor and materials and to the reconstruction and foundation work necessitated.

TREATMENTS WITH LIGHT OILS AND TARS

Over 600 miles of the older state highways were coated with light oils or coal tars at a cost of about $274 per mile. Most of the roads had been coated in former years, so that only from 0.2 to 0.25 gal. per square yard was required, with only a small quantity of sand or gravel as a covering. In a few cases heavy traffic necessitated a second application during the season. Including 700 to 800 miles of the older type of state highways the total cost of maintenance was from $620 to $650 per mile. A still greater amount of work needs to be done in 1917 because of work slighted during 1916 on account of the high level prices.

Ordinary maintenance, including the wages of the section men, cost $125 and patching, $155 a mile. The first item fairly represents the average for the 1155 miles of state highway. The cost of patching the older highways averaged about $220 to $250 per mile.

COMMISSION RECOMMENDS LEGISLATION

The commission's recommendations include legislation to enable the state to secure the money appropriated by the federal government for the improvement of rural highways and post roads; to authorize the commission to appoint a motor-vehicle commissioner to relieve the board of many routine matters relative to automobile licenses and traffic; to authorize the assessment of a special betterment tax on the adjoining land when it receives special benefit from the road maintenance, and that the state appropriate annually not to exceed $50 a mile to maintain trunk roads through towns of less than $3,000,000 valuation, but that none of the funds so accumulated shall be used in towns whose valuation per mile of road, exclusive of state highways, exceeds $50,000. A compulsory, graded and co-operative payment by the benefited towns is requested. The commission further suggests that an act be passed in 1917 appropriating $5,000,000 to be used in the construction of highways in the 5-year period beginning with 1918. Automobiles pay about $1,500,000 a year toward maintenance of through roads.

The total length of state highways at the end of the year was 1154.98 miles, and the total expenditures by the commission for the construction of state highways since the work began, including tree-planting, is $11,643,799. The counties repay to the state one-fourth of the cost of constructing these highways. On Sept. 30, 1916, the total amount of bonds issued was only $10,002,000. The sinking fund established to extinguish these bonds was $3,057,768, leaving a net debt of $6,944,232. The commission feels safe in saying that the state highways could not be replaced in the condition they are now in, although some are over 20 years old, for considerably more money than the net debt, and it doubts if they could be replaced, with the increased cost of labor and materials, for the gross amount of the bonds now outstanding.

Largest Pit in the World Used to Submerge Coal for Storage

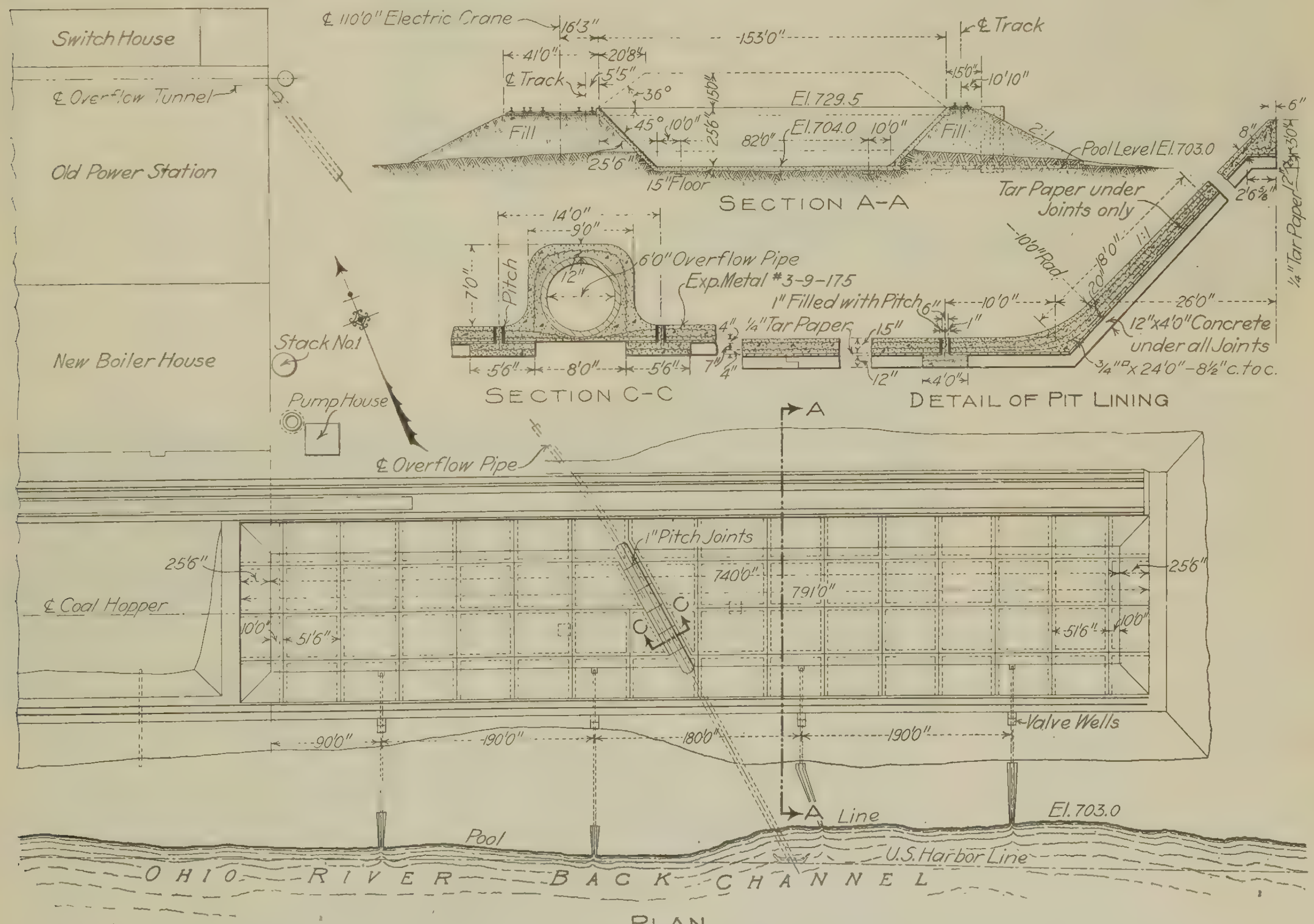
Spontaneous Combustion Prevented in 100,000-Ton Pile—Concrete-Lined Reservoir Has Waterproofed Joints

A HUGE PIT, 150 x 800 ft. in plan and 25 ft. 6 in. deep, with 45-deg. side slopes, will provide the Duquesne Light Company of Pittsburgh with safe storage space for a 100,000-ton pile of coal. The danger of spontaneous combustion will be prevented by submerging the coal in water up to the top of the pit, which is located near the company's main generating plant on Brunot's Island. The concrete lining was laid in blocks about 40 x 50 ft. in size, separated by construction or expansion joints waterproofed by pitch and tar paper above a 12-in. base of concrete 4 ft. wide. In lining the side slopes, traveling structural-steel frames were used to support the unit timber forms. Another special feature was the method of overcoming difficulty in keeping the 1-in. expansion joints clear while concreting slabs by adopting thin steel plates held in place by iron pins and clamps.

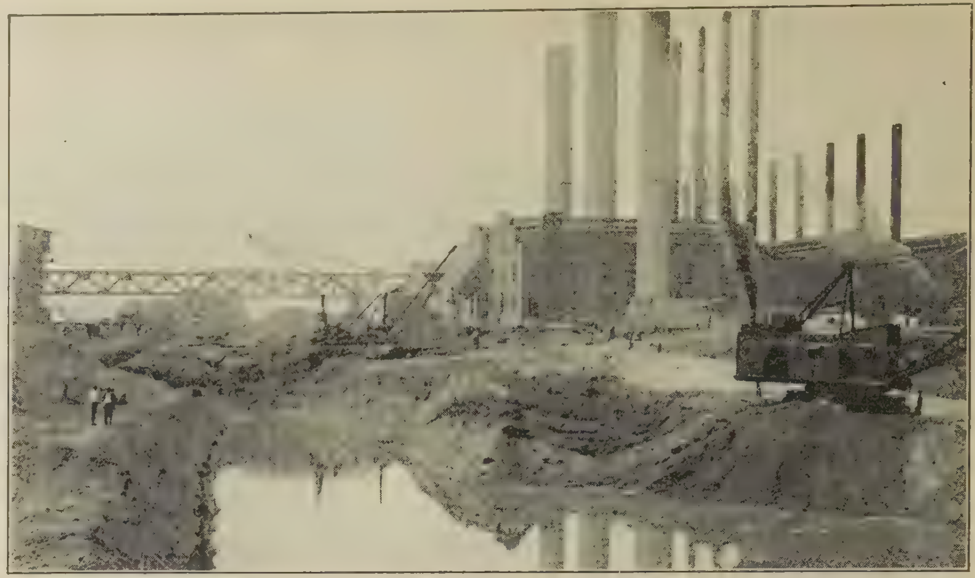
DESIGN OF PIT AND CONCRETE LINING

As illustrated by the accompanying plan and sections, the top of the reservoir is 153 ft. wide and 791 ft. long, and the depth is 25 ft. 6 in., so that with a surcharge of 15 ft. the capacity is about 100,000 tons of coal. The floor is paved with concrete 15 in. thick reinforced by two layers of expanded metal. The 45-deg. side slopes on the inside of the embankment forming the sides are paved with concrete reinforced by expanded metal and cast monolithically with a bottom section 10 ft. wide, using curved reinforcing rods at the intersection, as shown in the detail drawing. The thickness of the side slopes varies uniformly from 20 in. at the bottom to 8 in. at the top. The outer slopes of the embankments are protected by riprap built up of one-man stone.

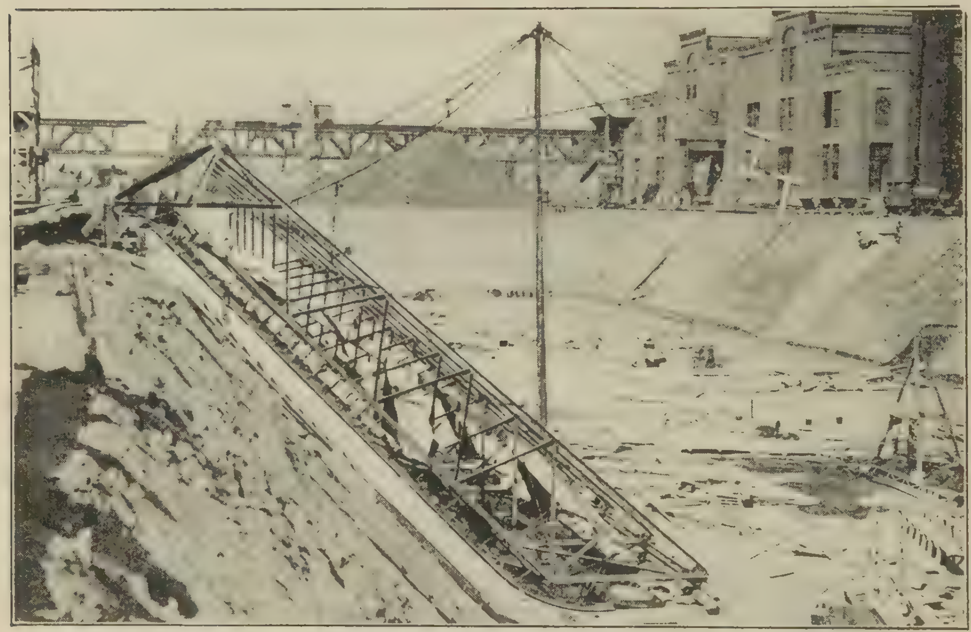
Water for submerging the coal is pumped into the reservoir through a 14-in. cast-iron pipe line leading from the power house to four 12-in. cast-iron outlet pipes placed 160 ft. apart in plan and about 6 ft. below the



PLAN AND SECTIONS OF HUGE COAL-STORAGE RESERVOIR—DETAILS OF WATERPROOFED EXPANSION JOINTS top of the reservoir. The 6-ft. concrete overflow pipe shown on the plan is in no way connected with the water system of the new reservoir, but was already in place when construction was commenced. The special covering of reinforced concrete shown on the drawing was designed to protect it from injury.


EXCAVATION MADE IN TWO LONGITUDINAL CUTS BY DRAGLINE EXCAVATOR

In order to prevent upheaval of the floor by uplift pressure if the pit were empty during flood conditions in the river near by, the drainage system, consisting of four 18-in. pipe lines located as shown on the plan, is equipped with check valves. These valves permit the water to rise inside the pit as the river rises in times of flood. The normal water elevation is at the level of the 15-in. concrete floor of the pit.


CONCRETE FOR SLOPED SIDES PLACED BY USE OF STEEL TRAVELING FORMS

Details of the special expansion joints are indicated on the drawing. These joints are placed about 51 ft. apart longitudinally and extend entirely across the base and sides with three longitudinal joints 41 ft. apart, as shown in the plan. Some difficulty was experienced in keeping clear the 1-in. open joints which receive the soft pitch between the concrete sections. The scheme finally adopted, which proved satisfactory, was to place 18 x $\frac{1}{8}$-in. steel plates 6 ft. long in vertical position along the curbs of the previously constructed sections and hold them in place by clamps over the top of the curbs, spacing them, to give the required 1-in. opening, by the use of round iron hook pins on 12-in. centers. These pins were easily removed after the floor slab had been cast. The steel plates, well oiled before placing, were then quickly taken out for use in a new joint.

LAYING SECTIONS OF 15-INCH CONCRETE FLOOR SLABS 51 X 41 FEET BETWEEN JOINTS

The excavation for the pit was made by a Bucyrus dragline excavator running two longitudinal cuts, the greatest depth of cut being 25 ft. At the east end embankments were required. The material for these was obtained by moving the excavated earth from the west end in 4-yd. dump cars.

A central concrete plant located on the river bank adjacent to the work was used to supply concrete for the pit and also for the construction of two large intake wells being built at the same time about 100 yd. away. Gravel and sand for the concrete were obtained in barges along the river and were hoisted directly into a bin with a capacity of about 150 yd. which fed a ½-yd. Haines mixer, from which the concrete was elevated by a tower and a part placed directly in position by a system of chutes. The remainder of the concrete was loaded into specially designed side-discharge cars and transported to points from which, by means of chutes, it could be placed in position.

SPECIAL STEEL TRAVELING FORM EMPLOYED

It was found necessary in order to retain the concrete on the 1 to 1 slope to use a special steel traveling form, designed and built by the Blaw Steel Construction Company, consisting of six trusses resting on rollers and traveling on single rails, one at the top and one at the bottom of the slope. The face forms proper were made of wood in removable panels about 3 x 10 ft. in size and were attached to angles by lugs, the angles being suspended from the trusses by rods fitted with turnbuckles to allow adjustment to proper alignment.

The pit, located near the main generating plant of the Duquesne Light Company on Brunot's Island, Pittsburgh, is being constructed by the Duquesne Contracting Company of Pittsburgh, of which J. J. Emes is superintendent and C. W. Gibbs, chief engineer. The design was made and construction supervised by F. Uhlenhaut, Jr., chief engineer of the Duquesne Light Company.

Use Home Materials for Road Work

Frank T. Sheets of Illinois Highway Department Urges Examination of Local Sources to Avoid Costly Long-Distance Haulage

GRAVEL and crushed stone are very heavy, their transportation is costly, and every endeavor should be made to ascertain whether suitable material can be obtained locally before they are imported at heavy expense, says Frank T. Sheets, assistant maintenance engineer of the Illinois Highway Department, in *Illinois Highways*. The surfacing of a road costs more than most people believe. In the case of eighty-seven gravel roads, the grading and drainage averaged 41 per cent and the surfacing 59 per cent of the total cost; in 104 waterbound macadam roads, the grading and drainage cost 35 per cent and the surfacing 65 per cent. In fifty-three bituminous macadam roads, these proportions were 27 and 73 per cent. These figures show, as interpreted by Mr. Sheets, that more than half the cost of a surfaced road is generally spent for the materials and labor employed in surfacing the graded and drained roadbed.

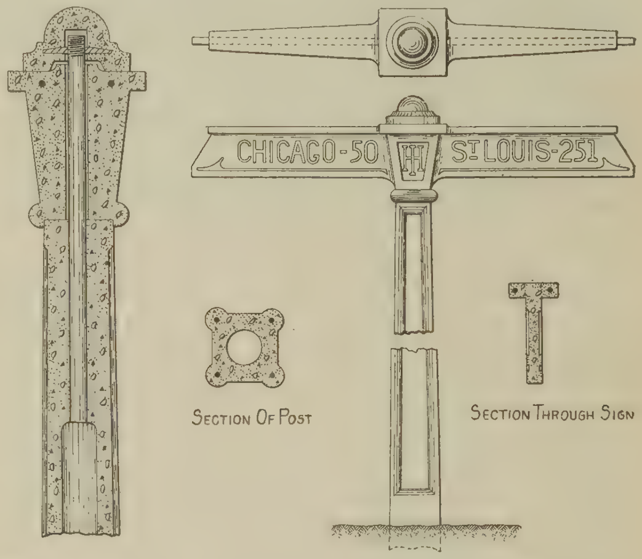
Usually the engineer is too busy to do much searching himself, but he can obtain much assistance if the local authorities will make systematic endeavor to ascertain the location of all ledges, sand banks and gravel beds in their neighborhood. These are public resources of real importance, and should be a matter of record. In some communities school children have been encouraged to search for them, and in many places local amateur geologists and mineralogists have done a public service while riding their hobbies. There can be no question that the lack of complete knowledge of this nature is needlessly increasing the cost of road construction and maintenance in many parts of the country.

Concrete Road Sign Wins Prize

Illinois Highway Commission Selects Design of W. H. Lienesch from Seventy-five Submitted in Competition

THE official state-aid road sign for Illinois has been chosen. The design for it was submitted by W. H. Lienesch, chief engineer for the Universal Concrete Products Company, Chicago.

Competition for the prize, which the State Highway Department posted in an announcement last June, brought designs from about 75 competitors throughout the United States, from California to Massachusetts. It was stipulated that the drawings should illustrate the proposed type of sign, to be erected along all state-aid roads.



THIS IS THE DESIGN WHICH WON THE PRIZE COMPETITION FOR ILLINIOS ROAD SIGNS

The accompanying illustration shows Mr. Lienesch's design. It was selected by the State Highway Commission, the Chief State Highway Engineer and approved by Governor Dunne because of its simplicity and durability, and its evident ability to serve the purpose to which it will be put. The sign is of concrete construction.

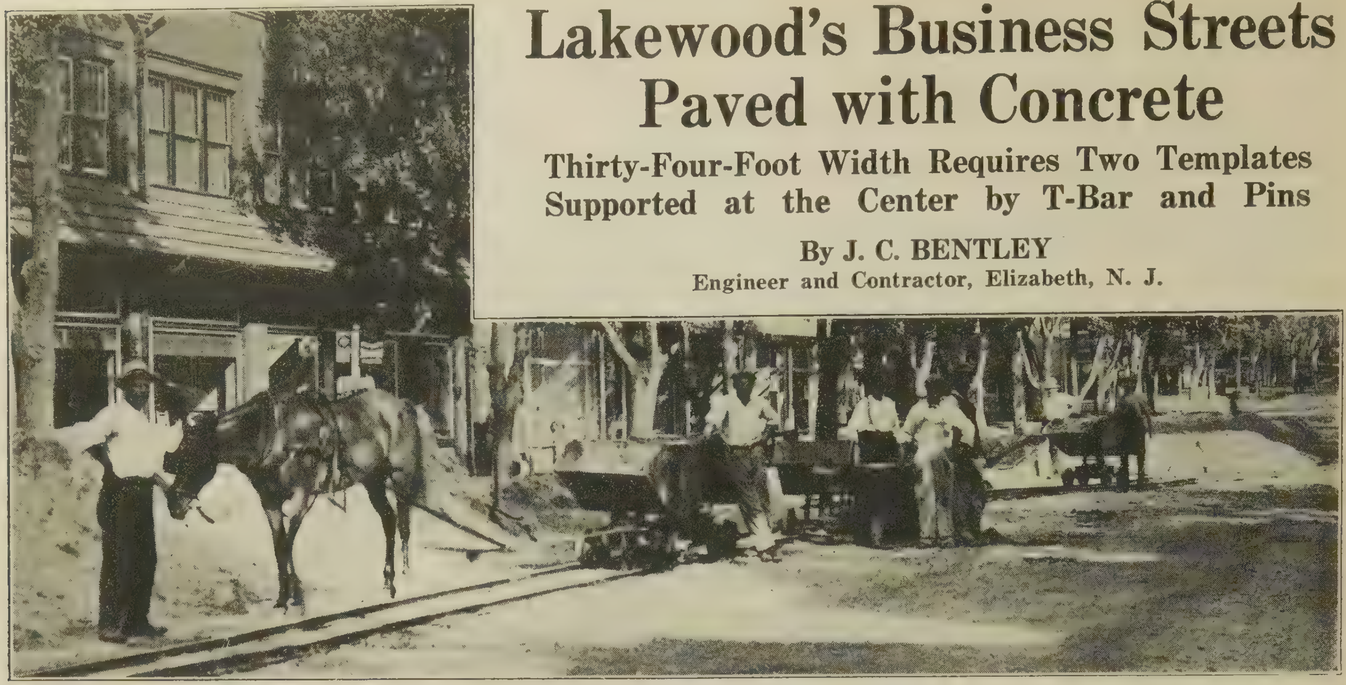
Concrete Road Contracts in 1916

Figures furnished by the Portland Cement Association show that contracts awarded for concrete pavements up to Dec. 1, 1916, reached a total of 24,929,148 sq. yd. Of this total 16,533,129 sq. yd. are roads, 7,501,739 sq. yd. are streets and 894,280 sq. yd. are alleys. There remain to be collected and tabulated the contracts for December which will make the 1916 total exceed 25,000,000 sq. yd.

Lakewood's Business Streets Paved with Concrete

Thirty-Four-Foot Width Requires Two Templates Supported at the Center by T-Bar and Pins

By J. C. BENTLEY
Engineer and Contractor, Elizabeth, N. J.



STRIPS ON BOTTOM OF LOADING SKIP OF MIXER ALLOWED SCOOP CARS TO BE ROLLED UP ON TRACK AND DUMPED

At Lakewood, N. J., there was recently completed the first permanent pavement laid in that town. After a careful investigation by members of the township committee a reinforced-concrete pavement without surface treatment was selected and the two main business streets, Clifton Avenue and Second Street, were paved with this material. The Clifton Avenue pavement, four blocks of 350 ft. each, was 22 ft. wide upon each side of a 9-ft. parkway. A 5-in. integral curb was constructed when the pavement was laid. Second Street was 34 ft. from curb to curb, and the improvement extended over three blocks of 600 ft. each. The work included, also, concrete curbs, catchbasins and drainage.

MATERIAL STOCKED AT INTERSECTING STREETS

Because of the scarcity of labor and anticipated difficulty in obtaining material promptly, and also to cause as little inconvenience to the business men along the two streets as possible, a method of construction not ordinarily used was decided upon for this job. Sand and stone were stocked at the intersecting streets at four places for the Clifton Avenue work and at three places for use upon Second Street. The streets selected were wide enough in all cases except two to permit stocking of material in the center, allowing traffic to pass on each side. Orders for sand and stone were placed as soon as the contract was signed, and these materials were being received and stocked while curb, basins, drainage, etc., were being constructed. Had material been dumped upon the sub-grade to be handled, as is usual, the streets would have been closed weeks in advance of beginning work.

The concrete was mixed in a self-propelled Chain-Belt batch mixer of 20 cu. ft. capacity, equipped with a delivery boom and bucket. To deliver material from stock piles to mixer scoop cars of 18 cu. ft. capacity, running on light 24-in. gage portable track, were used. The longest haul was 700 ft. upon Second Street and 400 ft. upon Clifton Avenue. The track was laid in the center of the street, upon the finished subgrade, extending under the mixer, a section being removed as the mixer moved ahead. Upon the bottom of the loading skip two iron strips were bolted. These strips extended about 12 in. over the edge of the skip, and when the latter was lowered the iron strips rested upon the top of each rail, allowing cars to be readily run into the skip and dumped.

The cars were first loaded with the required amount of sand, then filled with stone and hauled in trains of two cars by a horse and man to the mixer. Each car contained one batch. The cement was hauled direct from railroad cars to the job by the use of two skid wagons and one team with driver and helper. One wagon was left at the mixer, from which the cement man handled cement into the skip while the team with the extra wagon went after another load. This method not only saved labor expense but also loss of bags due to extra handling. Hauling also was done with a homemade tractor-trailer outfit, described in the "Hints for the Contractor" section, page 200.

HOW CONCRETE WAS SHAPED

The laying of the pavement upon Clifton Avenue presented no difficulties. Side forms level with the top of the integral curb along the parkway were set and the concrete struck off with a template resting upon the top of this form and upon the top of the curb. Afterward an inside form was hung from the side form and concrete was placed to form the parkway curb. Expansion joints were placed every 36 ft.

Upon Second Street pavement was laid from curb to curb, 34 ft., without longitudinal joints. To accomplish this two templates shaped for one-half of the street and constructed of 2-in. material, shod with iron and provided with iron handles upon each end, were used. These templates were run upon the top of the concrete curb at the sides and upon a screed or false center set parallel to the curbs in the center of the street. This screed was a 3-in. T-bar, 16 ft. long. Its flange was cut back at each end to permit the cutting of a slot 1 in.

wide and 3 in. long through the back of the T at the ends. This slot permitted the screed to be placed over iron pins upon which nuts securely held it at the proper elevation. These pins were about 30 in. long, threaded upon one end for two nuts; the other end was sharpened. About 18 in. from the point a shoulder had been formed upon the pins which, with the aid of washers 3 in. square, prevented any settlement after the stake had been driven into the subgrade. In sand it was found necessary to use wooden washers 8 in. square under smaller washers to prevent settlement. These pins were driven into the subgrade along the center line of the street 15 ft. 6 in. apart, ahead of the first layer of concrete. After reinforcement had been embedded in the concrete the screed was revolved to the pin ahead, adjusted to proper grade by use of nuts upon the pin and the top layer of concrete placed and struck off with templates. One side of the street was kept a little in advance of the other. This method worked very satisfactorily and a true and uniform surface resulted.

The usual wooden floats were used to float concrete. These were operated from bridges made from 2 x 12-in. yellow pine plank 36 ft. long arched with ½-in. rods and turn-buckles upon bottom and an occasional strut from rods to plank for the Second Street work. As many as six men have been seen upon one of these bridges at one time. Exceptionally good results were obtained in floating by the use of a mason's "darby." This was a float about 4 in. wide and 5 ft. long, constructed from light wood ¼ in. thick. It had a handle upon each end, and was similar to the long redwood floats used upon the California highways. Besides the split float at joints a curb template was used to insure a uniform curb face.

100 CUBIC YARDS PLACED DAILY

The concrete was proportioned approximately 1:2:3, the exact proportioning depending upon voids in the graded stone. A batch consisted of 18 cu. ft. of sand and stone and 4 bags of cement. The pavement, 15,000 sq. yd., was 7 in. thick throughout and reinforced with American Steel & Wire Company No. 28R mesh, weighing 34 lb. per 100 sq. ft. Pittsburgh paving joint was used at all expansion joints and along each curb. A day's work averaged 100 cu. yd. of concrete mixed and placed. On several days 125 cu. yd. were handled in 9 hr. with a crew of 22 men and foreman. Local men and foremen were employed throughout, although none had ever seen a concrete pavement before. No delays because of non-arrival of material were experienced after concrete mixing was started, and altogether the method employed proved very satisfactory, although doubtless somewhat more expensive than had the mixer been charged with wheelbarrows.

SCOOP CARS ON NARROW-GAGE RAILWAY DELIVERED MATERIALS TO MIXER

ACCEPTANCE CEREMONIES

To have one's work publicly accepted has seldom been the experience of road contractors. As an appreciation of the good work done by the contractor, Nov. 28, 1916, was proclaimed in the town as Acceptance Day. Upon that day there was a parade consisting of the several motor-equipped fire companies, local societies and orders, bands and all the school children. All buildings on the improved streets had been decorated. The streets were presented to the township by the contractor and accepted by their counsellor. H. K. Bishop, of Vermeule & Bishop, New York City, now district engineer, U. S. Office Public Roads, Washington, D. C., was engineer for the township, and the writer was the contractor.

A T-BAR, SLOTTED AT ENDS, WAS HELD IN PLACE BY ADJUSTABLE PINS TO CARRY ENDS OF TEMPLATES ON STREET 34 FEET WIDE

Fines for Heavy Loads on Soft Gravel Roads in Indiana

As a measure of protection for its gravel roads the Indiana legislature has passed an unusual "wet-weather law," imposing fines for the use of vehicles carrying excessive weights on narrow tires. At times when the roads are softened by water any person hauling more than 2500 lb. on tires less than 3 in. wide, more than 3000 lb. on 3 to 4-in. tires, more than 3500 lb. on 4 to 5-in. tires, and more than 3800 lb. on tires 5 in. or over is liable to a fine of from $5 to $50 for each load hauled. Such a law in itself, the American Highway Association points out, is not likely to be very effective, so the statute also gives the local road officials police power to arrest any offender against this law, and to encourage such arrests the official must be paid a fee of $2 for each person he arrests who is convicted. This law is directed against damage to the roads through misuse, but many roads are damaged by neglect as well, and so the Indiana lawmakers have provided that any local road official who does not maintain the bridges and highways in his charge in as good condition as the means at his disposal permit shall be fined from $5 to $100.

Colt's Plant Completed on Schedule Time

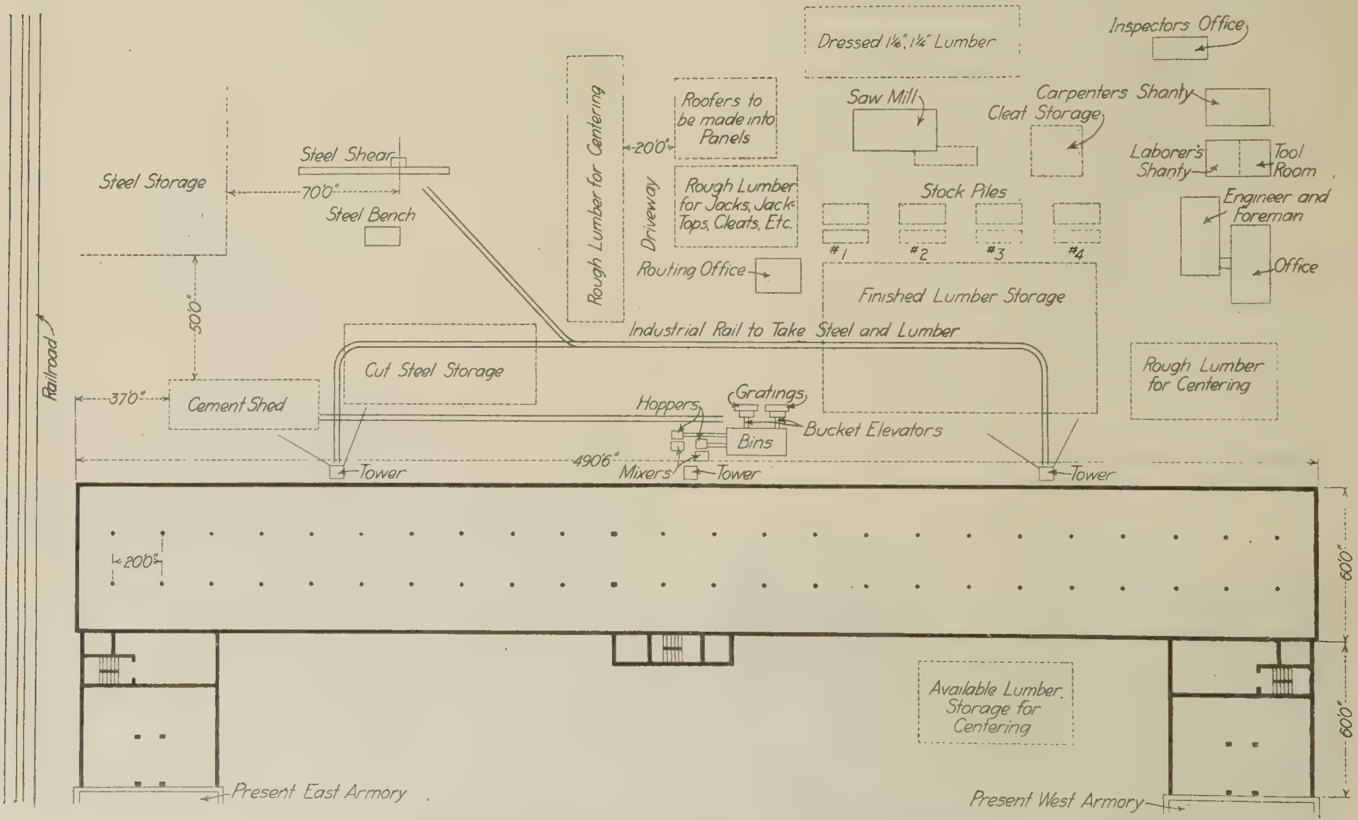
Story of Erection of 11-Acre Building for Hartford Manufacturing Firm Proves Organizing Genius of Modern Concrete Contractor

PLANNED to the last detail—the very number of workmen needed at each step and the means and time of delivery of each item of material known in advance—the construction of a large reinforced-concrete building for the Colt's Patent Fire Arms Manufacturing Company, of Hartford, Conn., was recently carried out in accordance to the day with a previously published progress schedule. The builders, the Aberthaw Construction Company, of Boston, did not reach this result by elaborate or unusual procedure, and but three months elapsed between the owner's decision to build and the completion of the four-story frame inclosing a floor area of 11.2 acres. Indeed, the only departure from the firm's customary practice in handling the work is stated to have been the advance publication of its progress schedule. The story of the planning and execution of this achievement is one of the application of hard common sense, with accuracy of detail but without delay of red tape, to the problem in hand.

By telephone appointment the contractors' engineers met the owners' representatives and the architects, Monks & Johnson, at Hartford on Monday, Aug. 21, 1916. The location and size of the building were there decided, and the conditions under which it should be built were arranged between the owners and the contractors. The work was undertaken upon a cost-plus-profit agreement, the same as on a previous building recently completed. The contractors became in effect the building department of the owners, bought all labor and materials, made all subcontracts and charged up everything at cost. For their executive services and profit they received a commission.

PLANS AND WORK START TOGETHER

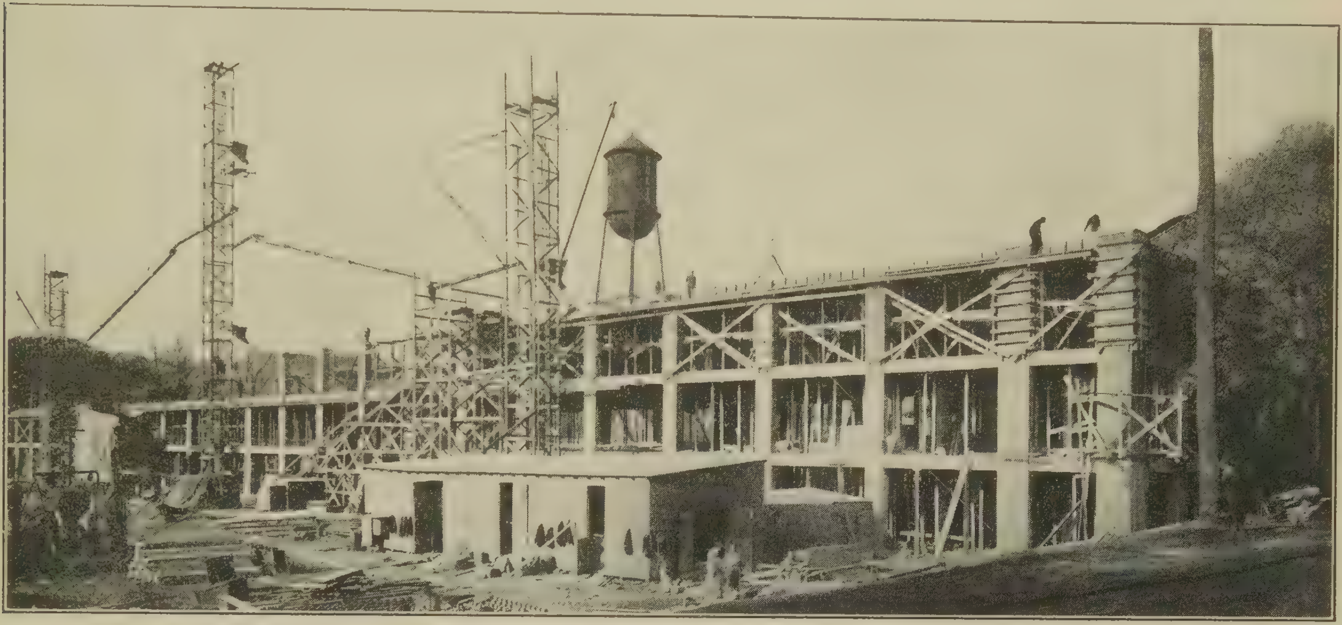
The architects immediately began on the plans, the contractors made up a probable square-foot-of-floor cost, began the clearing of the site and digging of test pits, and secured bids on footings and pile foundations. Coincidentally, after a quick but thorough survey of local conditions, such as the available vacant land, the railroad siding, the probable streets along which materials could be delivered, and nearby sources of materials that would be required, the engineering department made its first plant layout. Bins, sheds and office buildings were located and a place allotted for every class of material arriving on the job. This layout was subsequently perfected in the complete plan reproduced herewith.



LAYOUT ADJUSTED TO DELIVERY ROUTES, REQUIREMENTS OF CONSTRUCTION AND SPACE AVAILABLE

At the next weekly conference of the contractor's staff the entire job was taken up for discussion and definite organization. At this conference were present the man who secured the contract, two general superintendents, the chief engineer, the purchasing agent and the schedule engineer. The manager, who usually presides, was absent. The building superintendent was selected, together with his principal assistants, the carpenter, labor and planning foremen, the engineer and the master mechanic. The discussion covered plant layout, including number and location of mixers, method of distributing concrete, purchase and handling of lumber for forms, requirements in the way of steel and cement, prices and deliveries on these materials, architects' drawings, tentative progress schedule and many minor questions. Each man left the conference bearing definite responsibility for his part of the work.

The tests of the soil resulted in a decision to use piles, and the contract was given to the Raymond Concrete Pile Company. Two pile drivers were ordered on the job. In the shipping of one, which came from Boston, the Aberthaw company materially assisted their subcontractors in making quick time.



PHOTOGRAPHS TAKEN ON DATES GIVEN IN ANNOUNCED PROGRESS SCHEDULE SHOWED WORK ADVANCED TO SPECIFIED LEVELS

As a basis for all operations the schedule engineer immediately perfected his progress schedule, which is given in Table 1 in so far as it covers the direct work of the contractors.

Between the schedule engineer and the chief engineer the architects were kept informed as to dates upon which drawings must be in hand, and requirements in the way of form lumber, steel, cement, etc., were furnished to the purchasing agent. His responsibility ended when he had placed the order subject to specific deliveries. The superintendent on the job, being informed of the conditions of these orders, thereafter assumed responsibility for direct following up of the requirements. Any cases which he could not handle were referred back to the traffic department of the main office. Finally, cases which were beyond the power of the regular staff to straighten out were turned over to the manager to take up with the principal authority in the outside organization. In the case of subcontractors who were manufacturers, schedules were furnished and close touch was kept with the dates of beginning work and shipping the finished products ordered.

The situation was complicated by the New England freight embargo, but by having some source of supply or some method of handling always in reserve all serious delays were avoided. Plant, equipment, small tools

TABLE 1—PROGRESS SCHEDULE

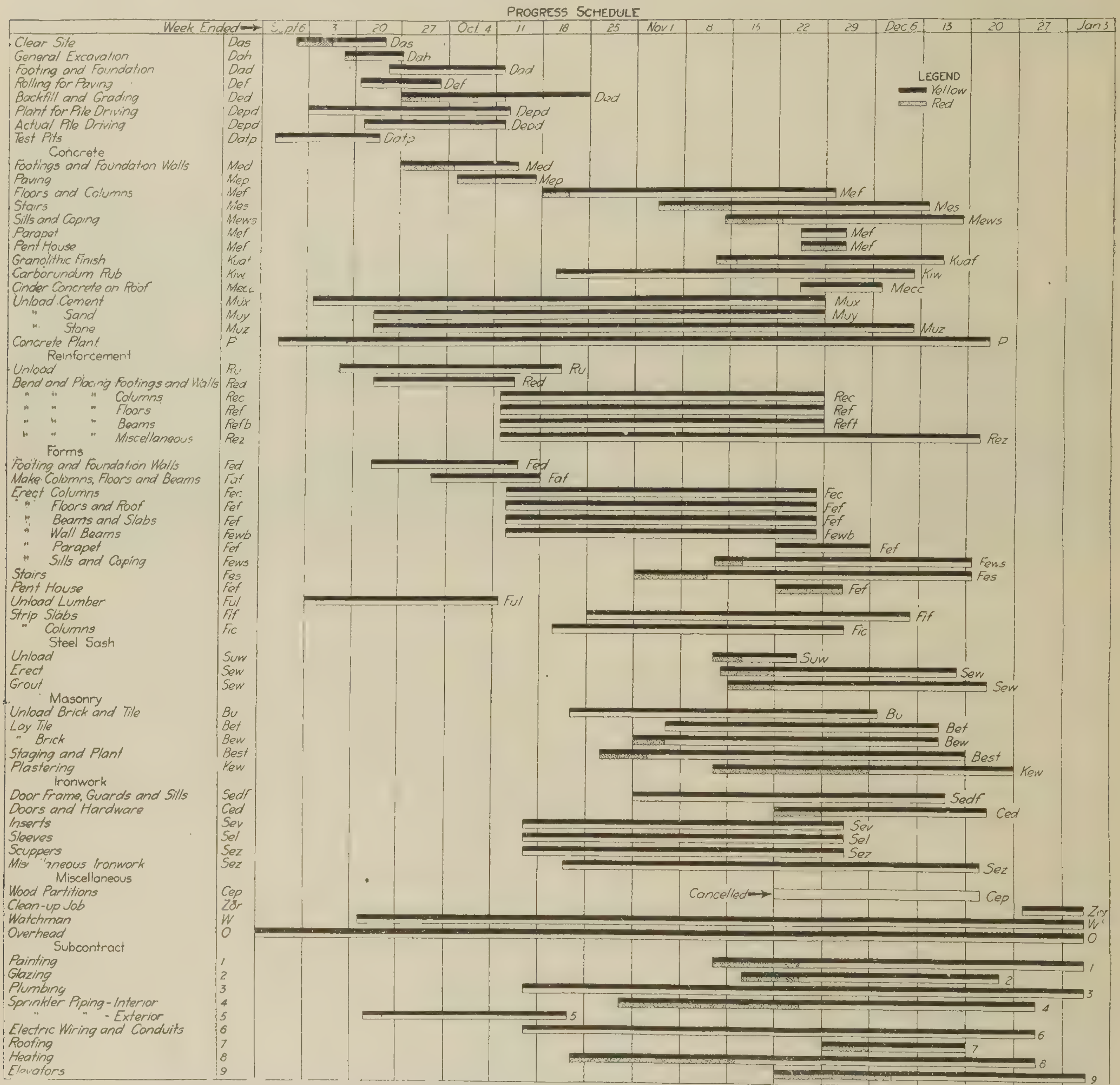
Item	Start	Finish
Clearing of site	Sept. 4	Sept. 16
General excavation	Sept. 11	Sept. 20
Footing and foundation walls	Sept. 18	Oct. 5
Rolling for paving	Sept. 14	Sept. 25
Backfill and grading	Sept. 20	Oct. 5
Driving of piles	Sept. 14	Oct. 16
Test pits	Sept. 1	Sept. 16
Concrete		
Footings and foundation walls	Sept. 20	Oct. 7
Paving	Sept. 28	Oct. 10
Floors and columns	Oct. 6	Nov. 23
Stairs	Oct. 28	Dec. 7
Sills and coping	Nov. 7	Dec. 12
Parapet	Nov. 18	Nov. 25
Penthouse	Nov. 18	Nov. 25
Granolithic finish	Nov. 6	Dec. 9
Carborundum rub	Oct. 13	Dec. 5
Cinder roof	Nov. 18	Nov. 30
Unload cement	Sept. 7	Nov. 22
Unload sand	Sept. 16	Nov. 22
Unload stone	Sept. 16	Dec. 5
Unload, erect and dismantle plant	Sept. 2	Dec. 16
Steel Reinforcing		
Unload	Sept. 11	Oct. 14
Bend and place columns	Oct. 5	Nov. 22
Bend and place footings and walls	Sept. 16	Oct. 7
Bend and place floor	Oct. 5	Nov. 22
Bend and place beams	Oct. 5	Nov. 22
Bend and place miscellaneous parts	Oct. 5	Dec. 15
Forms		
Footings and foundation walls	Sept. 16	Oct. 8
Make columns, floors and bins	Sept. 25	Oct. 11
Erect columns	Oct. 6	Nov. 21
Erect floors and roof	Oct. 6	Nov. 21
Erect Beams and slab	Oct. 6	Nov. 21
Erect wall beam	Oct. 6	Nov. 21
Erect parapet	Nov. 15	Nov. 29
Sills and coping	Nov. 6	Dec. 14
Stairs	Oct. 25	Dec. 14
Penthouse	Nov. 15	Nov. 25
Unload lumber	Sept. 5	Oct. 5
Strip columns	Oct. 13	Nov. 25
Strip slabs	Oct. 18	Dec. 5
Steel sash—Unload	Nov. 6	Nov. 18
Steel sash—Erect	Nov. 7	Dec. 12
Steel sash—Grout	Nov. 8	Dec. 16
Masonry		
Unload brick and tile	Oct. 16	Nov. 30
Lay tile	Oct. 30	Dec. 9
Lay brick	Oct. 25	Dec. 9
Staging and plant	Oct. 20	Dec. 13
Plastering	Nov. 6	Dec. 20
Door frames, guards and sills	Oct. 25	Dec. 10
Doors and hardware	Nov. 15	Dec. 16
Inserts	Oct. 9	Nov. 25
Sleeves	Oct. 9	Nov. 25
Scuppers	Oct. 9	Nov. 25
Miscellaneous iron work	Oct. 15	Dec. 15
Clean up job	Dec. 21	Dec. 30
Watchman	Sept. 14	Dec. 30
Overhead	Aug. 30	Dec. 30

and stationery scheduled by the building superintendent on a blank furnished for that purpose were immediately shipped. In accordance with the plant layout offices and storehouses were shipped from the contractor's yard, each building being made of standard sections 15 ft. wide in 10-ft. lengths.

The order for cement was placed, the storehouse was filled in advance of requirements, continuous shipments from the mill were maintained, and arrangements made with a local dealer so that his stock could be drawn upon in case of emergency. Sand and gravel were contracted for locally and hauled from near-by banks, of which the number was sufficient to guard against a tie-up with any one contractor. The storage bins were kept filled and daily deliveries made direct to the mixers. All scheduled form lumber, cut to dimensions, was turned out by a local mill, delivered on the job and piled separately according to size, ready for use. Because of the close proximity of the mill, and the fact that others stood ready to meet the requirements, daily deliveries were made and only a limited supply of lumber was kept on the ground.

To start the job reinforcing steel was shipped from the Aberthaw yard in Boston. With the exception of a few local emergency purchases handled by truck or auto there was no tie-up on account of steel, notwithstanding the freight embargo.

In the matter of labor the company's usual policy of transferring men from other jobs where they could be spared was maintained. Through the avoidance of hiring and discharging on the job the contractor has been able to build up an organization in which even the members of the shovel brigade average two years connection, while concrete laborers, steel men and carpenters remain three and four years in the service of the company. A material factor in holding men to-



DURING PROGRESS OF JOB VERTICAL LINES SHOWED DATES, WHILE CRAYON LINES REPRESENTED QUANTITY OF WORK DONE gether is the maintenance of the same rate of pay no matter where the man is at work. The number of men employed on the job on each of the principal dates specified in the construction schedule is given in Table 2. These are grouped according to the character of the work.

The chart which graphically represents the dates and limits and serves as a basis for recording progress is reproduced herewith. Three blueprints of it are sent to the job, one for the superintendent, one for the routing department and a third to be brought up to date weekly and sent to the Boston office. Another copy is kept on the bulletin board in the Boston office, and is brought up to date weekly from the copy sent in by the job. On the blank blueprint each item of work is represented by a wide white line. When an item of work is started it is recorded on the sheet by drawing a yellow line over the upper half of the heavy horizontal line. The length of the yellow line is made proportional to the amount of work done on that item, the entire heavy line representing volume rather than time, although it spans the period between the scheduled beginning and ending. It is therefore evident that the ratio of the length of the yellow line to the total length of the heavy line represents the proportion of the particular item of work which has been completed.

TABLE 2—MEN REQUIRED BY SCHEDULE

	Oct. 6	Oct. 21	Nov. 2	Nov. 13	Nov. 23
Laborers (including steel men)	83	79	109	96	90
Labor foremen	7	7	9	8	5
Carpenters	17	31	44	46	28
Carpenter helpers	26	42	73	81	49
Carpenter foremen	5	6	6	6	6
Master mechanics and mechanics	9	16	14	15	15
Cement finishers	..	6	16	14	16
Masons and tenders	..	..	8	9	18
All others	18	21	12	25	21
Totals	165	208	291	300	248

When work does not start on time a red line is drawn over the lower half of the heavy white line and is continued to the date when the work starts, when the yellow line is begun in its proper place. The red line therefore shows at a glance just how far behind work is upon the given item. Each week a piece of string is stretched vertically across the chart from the current date shown at the top of the sheet. If at any time the yellow lines extend beyond this string it indicates that the job is ahead of schedule on that particular item.

"FINISHED TO SCHEDULE"

Unusual attention was directed to the building by the advance publication of the proposed construction schedule and the issuing of periodic bulletins showing by photographs how it was being met floor by floor. Although the complete schedule was detailed nearly ten weeks in advance of the date of pouring the roof, the suggestion of publishing it was not made until some time later. Instructions were then given that work was to proceed exactly as on any other job. The principal dates in the construction schedule as published were as follows:

Oct. 6	Start superstructure
Oct. 21	Finish pouring concrete, second floor
Nov. 3	Finish pouring concrete, third floor
Nov. 13	Finish pouring concrete, fourth floor
Nov. 23	Finish pouring concrete, roof

After making the usual allowance for stormy weather the schedule showed forty-two working days for completing from foundations to roof the four-story concrete building, which is 490 x 60 ft., with a 60-ft. square wing at each end, and has a plan area of 2.8 acres. Although the work was actually completed in forty days, this was not due to speeding up, but merely to the fact that the anticipated number of stormy days did not materialize. In a word, the schedule was met to a day so far as the actual working period was concerned.

Thin Brick Reduces Paving Costs Nine Cents per Square Yard

Improvement in Construction Methods Claimed in the Use of Grout, Instead of Water, for Moistening Cement-Sand Cushion

By PARK H. MARTIN
Borough Engineer, Avalon, Pa.

NINE cents per square yard was saved in the repaving of California Avenue, Avalon, Pa., by reducing the depth of the brick blocks from 4 to 3 in., and what is believed to be an improvement over ordinary construction methods was inaugurated by moistening the cement-sand layer under the brick with grout instead of plain water, the latter having the tendency to wash the cement in the cushion layer from the top to the bottom, thus making a firm bond between brick surfacing and concrete foundation difficult to secure. Empowered by the council to buy all materials and engage all employees, the borough engineer had complete control over operations and was unhampered by politics.

ORIGINAL PAVEMENT 16 YEARS OLD

California Avenue is the main business street of the town. The average daily traffic comprises 1200 to 1500 automobiles, 300 trucks and 200 wagons. There is a double track street car line on the street, running to Pittsburgh, five miles distant, over which about 300 cars pass daily. The street car tracks are in the center of the street, with a space of about 10½ ft. between each track and the curb. The total width of the street between curbs is 36 ft., and 75 per cent of the vehicles travel on the part of the street between the car track and the curb, thus concentrating loads on relatively small portions of the paving.

The avenue was first paved about 16 years ago, the construction involving a 6-in. concrete base, sand cushion and wire-cut brick, with sand filler. The street had become filled with low places and holes, due to the foundation giving out and also to the bad effect of the street car tracks. Although the brick were badly chipped, they had not worn down on an average of more than ¼ to ½ in. The main fault was that the base of the street had played out.

3-INCH BLOCK RECOMMENDED

The fact that the brick had served 16 years and only worn down ¼ in. during a time when there had been heavy hauling with steel tired wagons led the writer to consider the use of 3-in. block. Observation showed that only 10 per cent of the present traffic is steel-tired, the balance being rubber-tired. This being the case there was apt to be less wear on the brick in the future than in the past, and the writer finally recommended to council the adoption of a 3-in. block on a cement-sand cushion with a grout filler.

The old base was to be resurfaced and brought to grade with concrete unless it was found to be in too bad a condition; in such case it was then to be removed and a new concrete base laid. Not knowing the exact condition of the base—how much was good or bad or how much concrete would be necessary to bring it to grade—we did not see how a contractor could bid intelligently on the work, and it was decided that the borough could best do the work with its own labor. The borough engineer was given complete control. Bids were taken on 3-in. and 4-in. block, and as recommended by the engineer, 3-in. Dunn wire-cut-lug block were adopted. The contract was awarded to the Bessemer Limestone Company, of Youngstown, Ohio.

LABOR SCARCE

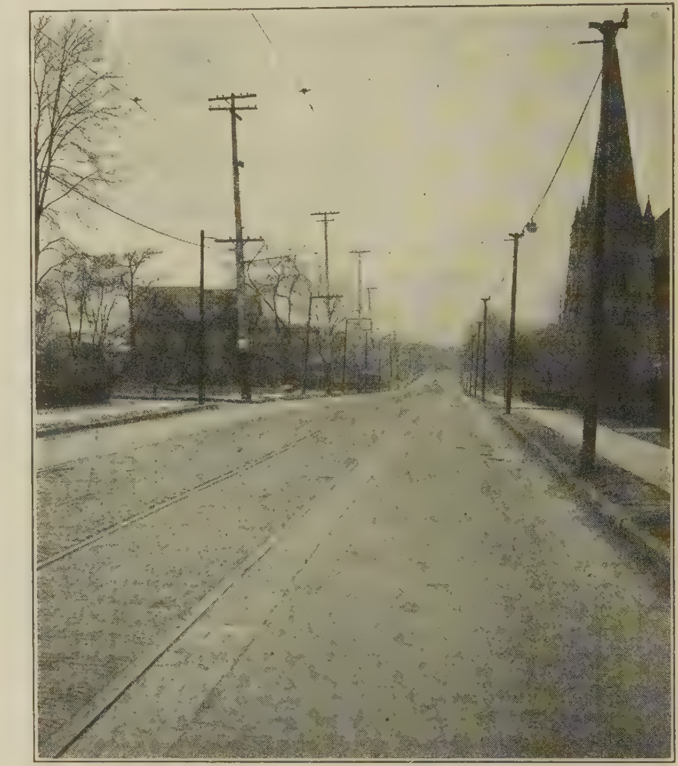
Labor was found to be very scarce, particularly because of the 5-mile ride to Pittsburgh and the fact that Avalon is purely a residential district. Labor was first paid 22½ cents per hour and worked a 9-hour day, but men could not be held at that rate; 25 cents per hour was then paid, but we met with indifferent success. Finally 28 cents an hour was paid and only the best of men engaged, but still labor was scarce and independent. Teams were paid $6 per day of 9 hours.

As there were about 450,000 brick taken up and we had no particular use for them it was decided to advertise them for sale. Council granted permission to sell about 200,000 of the old brick; the balance were stored for use around the borough. The writer fixed a price of $5 per thousand, the purchaser to haul the brick off the street. No trouble was found in disposing of the 200,000 brick to various people for drives, garages and chimneys. At this one stroke we salvaged $1,000, besides saving the expense of hauling and piling, an item which would have amounted to at least $1 per thousand. The foreman in charge of the work, who was an engineer, kept account of the number of square yards of brick taken up and hauled by any one purchaser; the number of square yards multiplied by 50 brick per square yard gave the number each received.

NEW BRICK COST $15.50 PER THOUSAND

The new brick for the work cost the borough $15.50 per thousand, f. o. b. Ben Avon Station, the nearest freight depot. They were hauled by four different draymen at the rate of from $2.50 to $2.75 per thousand. The haul was all uphill and about 1¼ miles in length to the middle of the work. The price, of course, included the labor of loading and unloading the brick from off the cars and at the street. We believe we have made a saving of about 9 cents per square yard in the cost of the paving, by the difference in price between the 3-in. and the 4-in. block and in the hauling, or a total saving of about $720 over the 4-in. block. Tests of brick were made by the Pittsburgh Testing Laboratory, and the average result is as follows: Abrasion loss, 20.31 per cent; absorption gain, 2.66 per cent; crushing, 11,433 lb. per square inch. The specified requirements were: Abrasion, under 24 per cent; absorption, under 4 per cent; crushing, over 7500 lb. per square inch. All material met the tests.

Two brands of cement were used—Universal and Crescent. All cement was tested by the Pittsburgh Testing Laboratory at the factory and all proved satisfactory. Cement cost $1.82 per barrel on the cars, and $1.92 per barrel in our cement house, with 40 cents per barrel allowed for containers. We accepted the price of $1.92 in the cement house, as the charge of 10 cents per barrel for hauling and unloading was as cheap as we could expect to do ourselves. Cement was all hauled by truck. The sand and gravel were purchased from the Rodgers Sand Company, of Pittsburgh, and was nearly all delivered by trucks from its Allegheny yard, a haul of about 4 miles. It was all river sand and gravel, and the cost on the job was as follows: Sand, $1.60 per ton; gravel, $1.40 per ton.



GROUT, INSTEAD OF PLAIN WATER, WAS USED TO MOISTEN CEMENT-SAND CUSHION FOR THE BRICK PAVEMENT AT AVALON, PA.

Prepared asphalt expansion joints, ½ x 3 in., were laid along the curbs and cost $2.13 per 100 ft., f.o.b. Ben Avon.

The Borough of Avalon owns a gasoline concrete mixer which it was the intention to use. It was found impractical, however, due to insufficient space between the car track and the curbs. The only way it could be used was by placing it on an intersecting street and hauling the concrete to the job. At some places the concrete was only 2 in. in depth and at others 4 in., and the space from the street car track to the curb was only about 10 ft. It was found, therefore, that the machine had to be moved too often to justify its use. The writer decided that hand mixing would be the cheapest and best. Accordingly a contract was made with James Very to lay the concrete base and also the brick. A price of 15 cents per linear foot of street 10 ft. wide was made for laying the concrete, without regard to depth. It proved to be a fair price and satisfactory to both parties. A price of 10½ cents per square yard was agreed upon for the work of making the cement-sand cushion, laying the brick, and applying the grout filler. This was to include the brick culling, but we found that unless we culled the brick ourselves they were not culled.

Under this arrangement Very's men laid concrete one day and brick the next, the one operation always keeping pace with the other. A big advantage in this was that while the base was still green the cement-sand cushion could be laid, thus insuring a far better bond between the two than if four or five days elapsed between the time of laying the concrete and that of laying the cushion. The concrete was laid in the proportions of 1:3:5. It was found essential to use a fine grade of gravel known as pea gravel to obtain the best results due to the shallow depth of concrete necessary to resurface the old concrete. In many places, however, as much as 6 to 7 in. of concrete was required to bring the street to surface, and the average over the entire street was 4 in.

CEMENT-SAND CUSHION

The cement-sand cushion was mixed dry, 1 part cement to 4 parts sand. The concrete base was first wet with a sprinkling can and then the cushion was laid. The cushion was shaped with a template and before the brick was laid it was sprinkled with a sprinkling can. Later in the work, the writer ordered that the empty cement sacks should be well shaken over the cushion after sprinkling and considerable cement was thus added to the top of the cushion. The brick were then laid and rolled. As a cushion of only 1 in. was laid, a 1000-lb. hand roller 30 in. in length was used and proved very satisfactory; it did not force the sand up between the brick and was quite a saving and convenience.

After rolling, the brick were culled, and then thoroughly wet with a hose. This was done partly to add water to the cement-sand cushion as well as to wet the brick. The grout was then applied in the proportions of 1 part cement to 1½ parts of sand. The first application was wet enough to run freely into the joints of the brick. After about 20 to 30 min., a second and thicker application was made. The grouting was always the last thing done in the evening and the finished pavement was allowed to stand until the next morning.

PROTECTION SAND ALLOWED TO REMAIN A WEEK

The following morning, sand taken up from the old cushion was brought back and spread over the work finished the preceding evening. Several times during the day the borough street sprinkler would be hauled along the street-car track and the finished pavement would be thoroughly wet; this was not only done as a matter of good workmanship to aid in curing the cement but to also settle the dust which naturally would rise from the sand being used as a protection to the pavement. This protection sand was allowed to remain on for about a week and was then removed, but the sprinkling was kept up indefinitely, to lay the dust. The pavement was kept closed for from 10 to 12 days before being opened for traffic. This was not as long a time as we would have liked, but due to the large amount of travel during the summer months, we were forced to open after that length of time.

The construction is what is called the semi-monolithic style, for which it is claimed that the cement-sand cushion forms a bond between the concrete base and the brick. Theoretically this appears to be all right, and as this was the first of this style of construction with which the writer had had anything to do, he naturally watched the results with interest, particular attention being paid to whether or not the cushion was setting not only to the base but to the brick, as claimed. Examinations showed that while the cushion was setting, it was not adhering to either the base or the brick. This led us to consider the reasons why. We always found that the top of the cushion would not set as hard as the bottom. The cushion is mixed dry, the particles of cement being simply mixed throughout the sand, but in no way a part of the sand. Water applied to moisten the cushion soaks from top to bottom. This action separates the cement in the top of the cushion from the sand and carries it to the bottom. It also has the effect of washing or cleaning the sand.

In mixing concrete the object is to coat every particle of gravel and sand with cement mortar. When each particle is coated and covered with the mortar, it naturally adheres. This action, however, does not occur in the cement-sand cushion. Instead of all of the particles being coated with cement mortar the opposite takes place, the water cleaning the sand rather than coating it. This led the writer to try the following form of sand cushion, which was adopted as a vast improvement over the one just described:

CUSHION MOISTENED WITH GROUT

The cushion was mixed dry, placed on the street and shaped with a template. Instead of clean water, cement grout thin enough to flow from a sprinkling can was applied to the cushion, thoroughly wetting the top. The brick were then laid upon this cushion and rolled. A very much smaller amount of water was then applied to the brick than formerly—in fact only enough to wet the brick so that they would not absorb the cement grout. Then the brick were culled and brick taken out at various places for inspection. It was found without exception that the cement-sand cushion always clung to the bottom of the brick, thus proving that there was a complete bond, something which we never found until we applied the cement wash to the cushion.

The writer feels satisfied that this is a big step in the construction of brick pavements of the semi-monolithic type. He believes further that it would be a good thing if, before applying or laying the cement-sand cushion upon the concrete base, a thin cement grout were sprinkled over the base, thus causing the cement-sand cushion to adhere to the base as well as to the brick. The writer believes this will equal the monolithic type of construction and will be far better in view of the fact that it permits continuous work without waiting for the base to get its initial set. It also permits walking over the top of the brick and is much better for rolling, as there is no danger of getting an uneven surface due to the concrete not being set, as is the case in the monolithic construction.

The total cost of the work done was $14,089.87, from which should be deducted $291.50 paid by the gas company, leaving the cost to the borough $13,798.37. From this item $1,000 should be deducted for old brick sold from the street, leaving a total net cost to the borough of $12,798.37. A total of 7875 sq. yd. of paving was laid, giving a unit cost of $1.75 per square yard. This includes removing old brick, removing and hauling away old cushion, laying the concrete base, cement-sand cushion, grout filler, etc., and is made up as follows:

Cost Per Square Yard

Cement-sand cushion, laying brick and grout filler	$0.275
4-in. concrete base	.440
Brick hauling	.105
Brick	.620
Removing old cushion, tearing up brick and hauling away, etc.	.290
Expansion joint, testing brick, water, lumber and tools	.060
Total per square yard	$1.79

Deduct 4 cents for concrete laid for the gas company, leaving net cost to borough, $1.75 per square yard.

While we were doing this work, the borough had let contracts to the amount of $35,000 for the paving of various other streets. The bid by the lowest responsible contractor to do this work was as follows: 5 in. concrete base, ordinary sand cushion, 3 in. brick and sand filler, $2.12 per square yard. This does not include any excavation, and compared with our cost of $1.75 per square yard shows a saving of 37 cents per square yard, or that we have made a total saving of about $3,000. The difference of 1 in. in the concrete base as laid by us and as bid by the contractor was more than made up by the fact that his bid covered an ordinary sand cushion and sand filler while we laid a cement-sand cushion and a grout filler. We have also made an additional saving of about $300 in inspector's fees, as it was necessary for us to retain an inspector on our own work.

The street is about 4500 ft. long, and some parts have been laid and traveled over for about four months, and all of it for over two months. Its appearance is excellent, and the quality of work seems to be all that could be desired.

Water for Canal Lockages

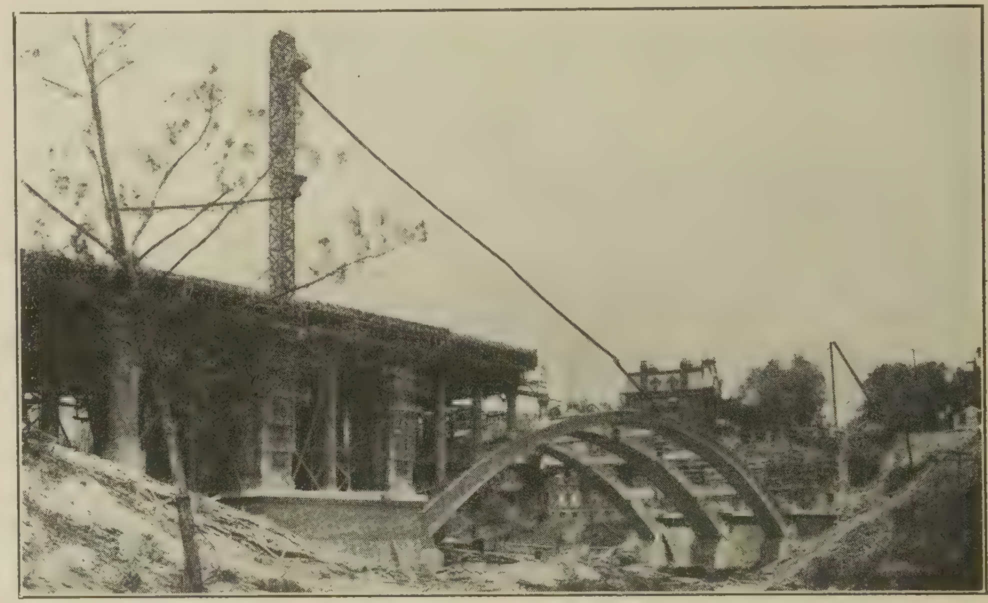
From a study made of the water supply for the Panama Canal it was ascertained that an average of 7.21 million cubic feet of water was used for each through lockage from ocean to ocean; that an average of 12,787.47 million cubic feet of water was wasted over Gatun spillway, or a sufficient quantity of water to make 1773 through lockages each month. Based on 30-day operation this would mean 59 lockages per day over and above the average traffic for the past year. According to the latest annual report of the governor of the Panama Canal, the maximum number of lockages which can be made in 24 hours is 48, assuming that one vessel leaves the upper flight at Gatun just as another enters the lower chamber, and vice versa, both chambers being used.

Appearance Governs Design of Park Avenue Bridge, Cincinnati

Massive Abutments of Cellular Type Support Heavy Piers—Curved Outlines Adopted for Beams and Brackets

By J. R. BIEDINGER
Assistant Engineer, Engineering Department, City of Cincinnati

REPLACING an old wrought-iron bridge which had become inadequate for modern traffic, the new reinforced-concrete bridge which carries Park Avenue, Cincinnati, over the Kemper Lane ravine into Eden Park exemplifies the modern tendency toward suitable architectural treatment. Among the special features designed to improve the appearance of the structure are the use of curved or arched outlines for stringers, floorbeams and sidewalk brackets, molded capitals and bases for the spandrel columns, ogee moldings for the main outside ribs, and unity in the treatment of the approach spans, heavy cellular abutments and the piers above them. The design of these massive cellular abutments also contains elements of unusual interest in the use of inclosing slabs and molded copings.

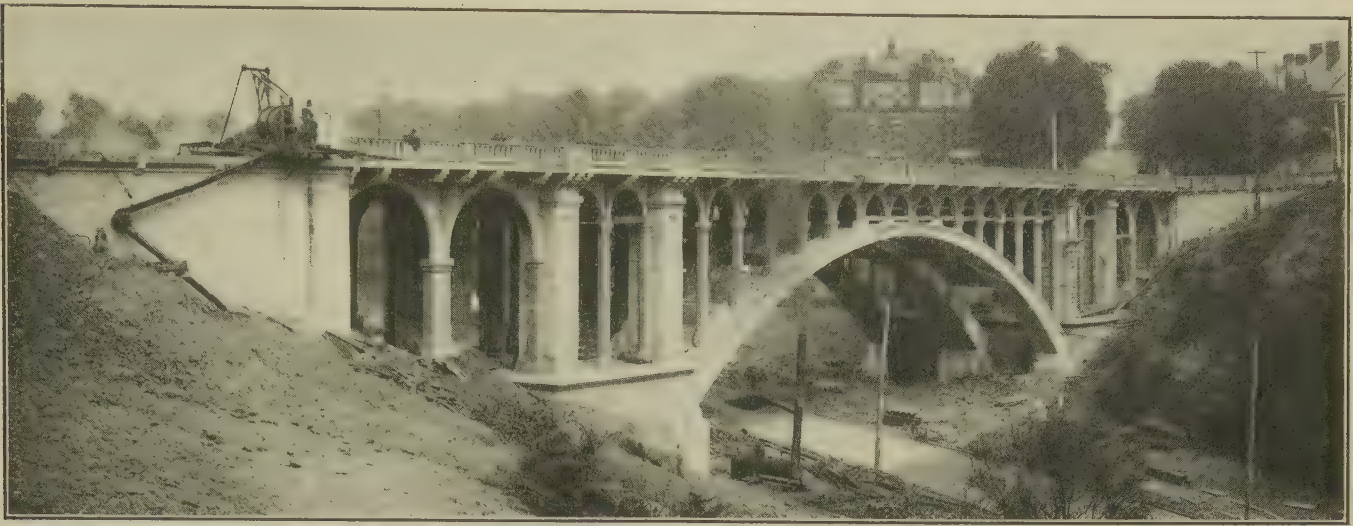


ARCH RIBS COMPLETED AND FORMS REMOVED—NOTE MASSIVE APPEARANCE OF ABUTMENTS

Location and General Dimensions

The Park Avenue Bridge, located symmetrically over the Kemper Lane ravine, and carrying Park Avenue into Eden Park, consists of a single main arch span 180 ft. long, with massive abutments, above which are heavy piers to carry the roadway, with arched stringers similar to the arched approach spans on each side. The roadway is 40 ft. clear width. Two sidewalks, 12 ft. 6 in. wide, are carried by cantilever cross-beams with curved outlines.

The three main arch ribs are rectangular in section, the two outside ribs are 6 ft. 9 in. wide and the center rib 10 ft. wide—all varying in depth from 3 ft. at the crown to 6 ft. at the springing lines. The span is 180 ft. and the rise 31 ft. for the center line of the arch ribs. The reinforcement consists of longitudinal rods



CURVING OUTLINES, MOLDINGS AND COLUMN CAPITALS, MASSIVE PIERS AND ABUTMENTS IMPROVE ARCHITECTURAL EFFECT

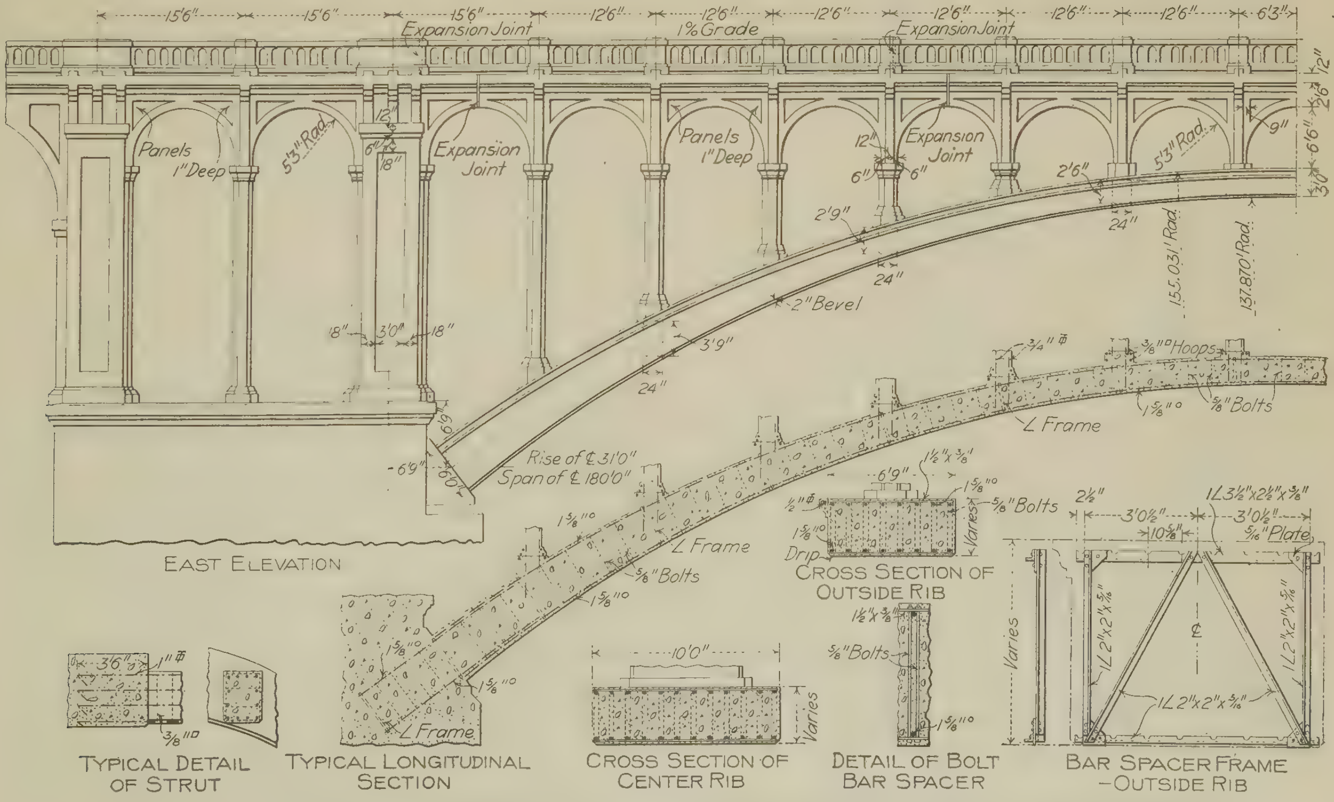
amounting to 1 per cent of the crown section divided equally between the upper and lower sides. This longitudinal steel is well tied together with special ⅝-in. bolts between plates to form U-bars. Where splices occur special clips are used.

In order to insure accurate spacing of the longitudinal steel, which is quite heavy, special spacer frames, as illustrated in one of the drawings, were adopted.

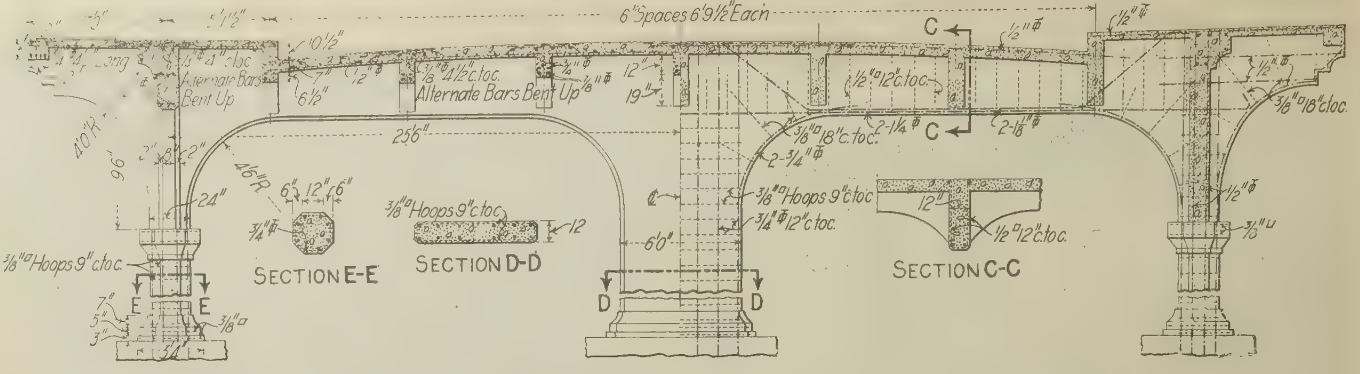
ARCHITECTURAL FEATURES

As the structure is in line with one of the proposed boulevards of the city, as well as in Eden Park, particular care was taken with the architectural treatment. The course of Kemper Lane is changed to make it pass under the center of the arch, and the sides of the ravine are graded to approximately the same slopes. Throughout the entire structure sharp corners and angles are eliminated as much as possible. Curved cantilever brackets carry the sidewalks and the posts of the open railings. Arch outlines are used for stringers and cross-beams, and paneled spandrel arches spring from molded capitals above the spandrel columns. These spandrel columns rest on molded bases on the arch ribs. The outside main ribs have large ogee moldings on the top outside corners.

Prominent skewbacks are seen in the massive-appearing abutments, which are also finished by ogee copings similar to those on the arch ribs. The architectural treatment of the approach spans and the retaining walls is made to harmonize with that of the main span. All panels and flat surfaces of the entire structure are bush-hammered. From the northeasterly corner of the bridge a concrete stairway follows the slope down to Kemper Lane.

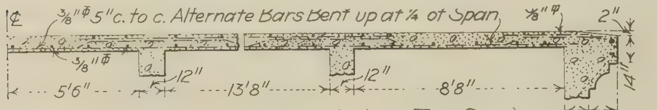


TYPICAL SECTIONS AND HALF ELEVATION OF MAIN ARCH—ANGLE FRAMES FOR SPACING REINFORCEMENT

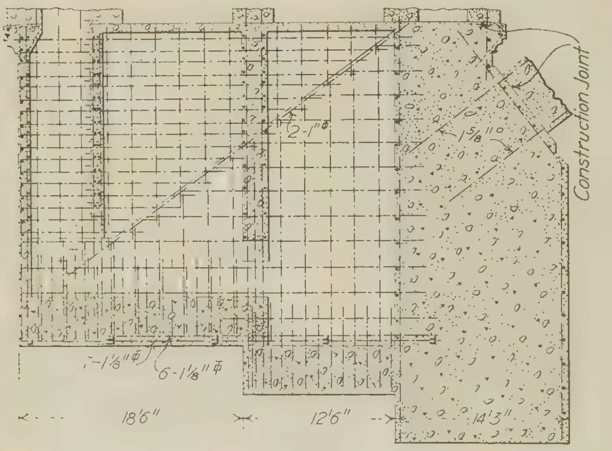


CROSS-SECTION OF FLOOR ABOVE ARCH RIBS—ARCHED OUTLINES ARE USED FOR GIRDERS

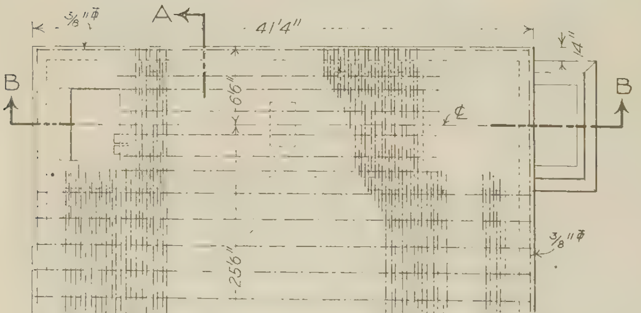
Tongue-and-groove expansion joints allow longitudinal movement of the deck, the 1-in. vertical spaces of the joints are filled with tarred felt and the horizontal joints are formed by a thin layer of tar paper separating the concrete surfaces. The floor adjacent to expansion joints is supported by cantilever beams. Rectangular struts, as shown in the sectional drawing, are provided about every 25 ft. between the main ribs, to give lateral stiffness.



ENLARGED SECTION A-A OF TOP SLAB



SECTION B-B



HALF PLAN OF TOP

CELLULAR TYPE OF ABUTMENT—NORTH ABUTMENT SHOWN

The spandrel arches and also the approach arches were designed as beams and not as true arches. The cross-beams were designed as continuous beams over three supports, the overhang of the sidewalk brackets being considered as part of the beams in the design.

LIVE LOADS AND ALLOWABLE STRESSES

The live loads used in the design are as follows: Roadway slabs, 600 lb. per square foot; sidewalk slabs, 100 lb. per square foot; cross-beams and stringers, 20-ton road roller with 20 per cent impact or 150 lb. per square foot on the roadway; arch ribs, 100 lb. per square foot over the entire bridge. A temperature variation of 60 deg. Fahr. was used in the design of the arch ribs.

The allowable stresses were: Tension in steel reinforcement, 18,000 lb. per square inch, except in the abutments, where 20,000 lb. was permitted; compression in concrete, 650 lb. per square inch in slabs and beams, and 700 lb. in the abutments. In the arch ribs a maximum compressive unit stress of 650 lb. was allowed on the equivalent section (n taken as 20) for dead and live load stresses and 800 lb. for the sum of all stresses, including temperature and rib shortening. As all beams are liberally provided with shear bars, a maximum value of 150 lb. per square inch was allowed in shear.

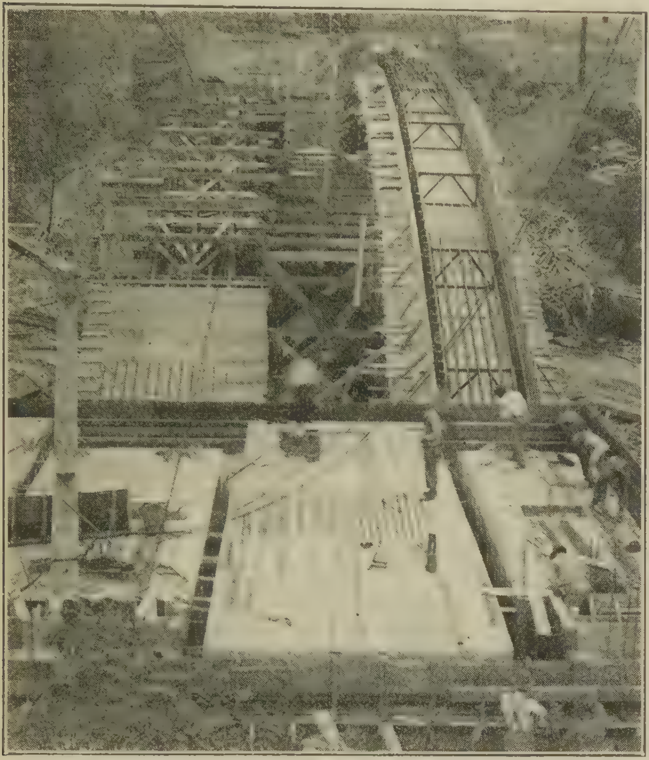
On clay foundations the maximum soil pressure allowed was 4000 lb. per square foot; and on rock, 10,000 lb. per square foot.

CELLULAR ABUTMENTS

The massive appearance of the main arch abutments was attained economically by using a cellular design, as indicated by one of the drawings. For each main arch rib there are two abutment ribs with sloping top surfaces, well reinforced with steel and tied into the stepped footing slabs with shear bars to insure ample strength. The footing slabs are stepped to give an added factor of safety against sliding on the foundations. The curtain walls on all four sides and the top slab, all reinforced with steel, inclose the abutments and give the appearance of solid blocks of concrete. Drainage pipes connected to a nearby sewer are placed in the floor of each abutment to prevent the accumulation of seepage water.

The retaining walls are mainly of the buttressed type. As filled ground was encountered under some portion of these walls, it was found necessary to place supporting walls carried to rock under the buttresses. The footings for these walls were so designed that the foundations receive practically uniform pressure.

The structure was designed by the writer under the direction of the Engineering Department of Cincinnati, of which Frank S. Krug is chief engineer and Frank L. Raschig, principal assistant engineer of the Department of Structures. The construction was supervised by Paul Laur, assistant engineer of construction, and R. J. Coffin, resident engineer. D. P. Foley is the contractor for the work.


FORMS IN PLACE FOR CELLULAR ABUTMENT AND OUTSIDE RIB

Advantages of Fixed Set-Back Lines

Two chief advantages of establishing set-back lines have been pointed out by Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment, New York City, in a report to the Committee on City Plan. One is the protection of those who have bought and improved their property, particularly in residential districts, under restrictive covenants, which later expire and thus expose the property owner to loss and depreciation when adjacent lots are improved by buildings flush with the property line. The other advantage is in the possibility of laying out streets of less width between street lines, which would yet serve the local traffic for many years. If more roadway capacity were then needed, part of the space between the street lines and the set-back lines could be added to the street. Thus a street could be paved at a smaller initial cost to the owners and the city would save the cost of maintaining an unnecessarily large area of pavement. This fixing of building lines back of the street lines should be done as part of the city plan, and would be limited to sections still undeveloped, or those of a distinctive character which it is desired to preserve.

Michigan Puts Selection of Road Types on Business Basis

Road-Mile Method of Valuation Followed — Diagram Prepared to Show Relative Costs Per Vehicle-Mile for Different Surfaces

By D. A. THOMAS
Michigan State Highway Department

THE Michigan State Highway Department, in common with similar organizations in other states, has made a study of the selection of road types, and has reduced to tangible form a few principles which, together with a knowledge of the capacity of different roads for service gained from experience, are useful in aiding county and township officials to choose the proper road to build. It is not believed that the problem of selection has been reduced to a finality. A few ideas are presented here, however, in the hope that they may be of some value to others and may promote the further study of the road situation necessary to produce roads which are above criticism and worthy of rank as engineering achievements and to reduce the present enormous waste of money available for highway purposes, in so far as it is possible to do this by proper selection.

ROAD MUST SATISFY USERS

It is highly important that a road be satisfactory to a majority of its users; no road can otherwise be called good. If a road is built which is unsuited to the needs of the traffic or which is not maintained in a manner which will enable it to meet the demands made upon it, the people of a community often become prejudiced against all roads of the same type and frequently give preference to high-cost roads in locations where low-cost roads would suffice. This difficulty can largely be corrected by the selection of road surfaces which are calculated to meet the demands of the traffic.

Gravel roads, for example, are popular in Michigan, and have demonstrated their ability to stand up under the average country road traffic, which is largely automobile, but less than 400 vehicles per day. They constitute 3000 miles, or 60 per cent of the total improved road mileage in the state to-day. In perhaps 85 per cent of the cases they are rendering satisfactory and efficient service. This figure could be bettered if all roads received uniformly good maintenance. The popularity of gravel roads, however, frequently leads local authorities to decide to construct them under conditions where they are certain to prove unsatisfactory and expensive.

SELECTION OF SUITABLE TYPE OF ROAD REAL PROBLEM

To select a road that is within the ability of the county to pay for is the real problem in many instances. Any type of road will prove expensive for only a few vehicles per day. It is desirable to study the local road-building materials from every standpoint, and to make the selection only after careful investigation. When in doubt, the cost and success of different types under similar conditions in other locations are good criterions to follow.

Some concessions on the part of the user are often necessary. The sensible person fits his expenditures to his circumstances, and the same is true of communities.

Yet frequently we hear complaints because a county is not intersected everywhere with roads as smooth as a billiard table. As a matter of fact, Lake County, Michigan, one of the poorer counties of the state, is showing good judgment in restricting its road building to gravel roads costing $2,000 a mile. The county is not able to build roads costing $16,000 a mile as Wayne County is doing, and such expensive roads are not needed.

Most estimates of a county's financial ability to build roads are based on the annual tax receipts, which are in proportion to the assessed valuation. This is not the most logical basis for sound judgment. A better measure is obtained by dividing the assessed valuation of a county by the road mileage within its borders, giving the valuation per road-mile. It is not assumed that it will be necessary to build all the roads in a county, but the roads needing improvement will be in direct proportion to the total. Thus, of a number of counties under comparison that one should best be able to improve its roads which has the greatest valuation per road-mile, although all may have somewhat the same assessed valuation.

VALUATION BY ROAD-MILE METHOD

Lake County, which is rated at $3,980 per road-mile, is lowest in the point of road valuation. Thus it would take all the money that the county is assessed for to improve its roads at $4,000 per mile. At the other extreme is Wayne County, with a valuation of $609,000 per road-mile, which is 150 times as large as the road-mile valuation in Lake County. Under these conditions Wayne County is about nineteen times as able to build concrete roads at $16,000 per mile as Lake County is to build gravel roads at $2,000 per mile. Oakland County, adjoining Wayne County, has a valuation of $36,300 per road-mile. It has built, among others, several miles of concrete roads at $14,000 a mile, thereby stressing itself to about the same extent as Lake County.

The desired end is of course to recommend, where they are needed, roads which will stress the counties to somewhat the same extent. Wayne County can undertake any improvements within reason. Oakland County can afford to build the heaviest-traveled roads of concrete or brick where this type is necessary to take care of the travel, but from an economical standpoint cannot afford to build the lesser-traveled roads of these materials.

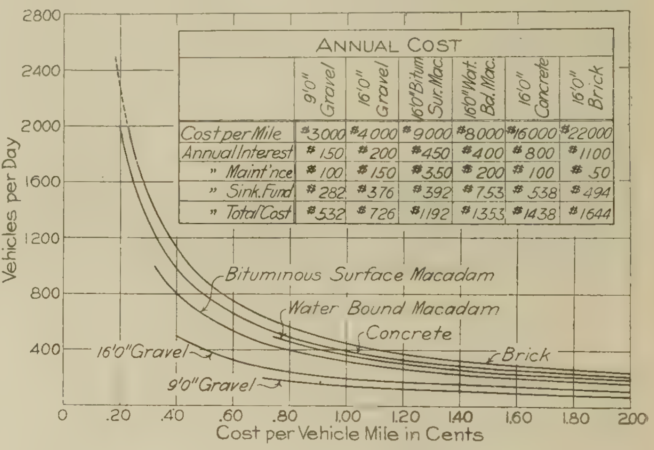
BARRY COUNTY ROADS AVERAGE $4,000 PER MILE

Barry County, on the other hand, in the center of a rich agricultural district and adjoining Kent County, in which Grand Rapids is located, has a valuation per road-mile of only $16,950. So far its roads are built of gravel at an average cost of $4,000 per mile. It is conceivable, however, that this county may require roads of a higher class in the future. It is apparent at once that $16,000 concrete roads would burden the county, but it could afford to build bituminous-surfaced macadam roads at $9,000 per mile in about the same ratio of cost to valuation per road-mile as Lake and Oakland counties.

Such a schedule as is proposed is subject to various modifications. As a matter of fact 9-ft. gravel roads, such as Lake County is building, cost on the average throughout the state $3,000 per mile. A selection cannot be made without a knowledge of local conditions, and the fact that a county possesses a low valuation per road-mile would not outlaw a certain type where the traffic actually demanded it. Finally, since a system of state-aid is in force in Michigan, and as the first cost is not the true cost of a road, the construction costs used as the basis of comparison do not represent the actual cost to the county. Notwithstanding this, the principles here stated are valuable in determining the extent to which it is wise for a county to go in building roads.

HOW ROAD FUNDS ARE WASTED

Again, a road may be entirely satisfactory to its users, entirely within the ability of a county to pay for, but uneconomical. Such is usually the case where a high-cost road is built for a few vehicles per day. Perhaps in no other field where engineering knowledge is essential is there such a lack of the application of scientific principles as in the selection of road types. This is due to the fact that a large share of the money spent on roads is paid out by men who do not know what is needed. If a business man made the mistakes that are made in highway construction he would be bankrupt inside of a year. Fortunately it is not possible to bankrupt the taxpayers. From an engineering standpoint, however, it is the duty of those in charge to spend the money in a scientific and economical manner.



ANNUAL COST	9'0" Gravel	16'0" Gravel	16'0" Bitum. Sur. Mac.	16'0" Wat. Bd. Mac.	16'0" Concrete	16'0" Brick
Cost per Mile	$3000	$4000	$9000	$8000	$16000	$22000
Annual Interest	$150	$200	$450	$400	$800	$1100
" Maint'nce	$100	$150	$350	$200	$100	$50
" Sink. Fund	$282	$376	$392	$753	$538	$494
" Total Cost	$532	$726	$1192	$1353	$1438	$1644

COST PER VEHICLE-MILE FOR ROADS OF DIFFERENT TYPES

In a system so large as to serve a whole state, nearly every type of road has its place, and the same is true of many counties. It is a familiar fact that in general the traffic over a road decreases as the distance from cities and towns becomes greater. It is the experience in Michigan that even on trunk lines the local traffic amounts to about 85 per cent of the total. Yet there are those who would build nothing but high class, hard-surfaced roads everywhere without stopping to consider that to do so may sometimes be as ridiculous as to put on a dress suit to feed the cows.

A careful study of traffic conditions and a count of the number and kind of vehicles passing over the road daily are of prime importance. In localities which are financially able to carry out any improvements within reason the traffic is the logical basis on which to select a road. After making the necessary allowance for future increase, that type should be selected which experience has shown can be made to carry the traffic imposed upon it for the least annual cost, taking into account interest on the first cost, maintenance, and a sinking fund which will renew the surface when it wears out or will retire the bonds if built by bond issue. If analyzed, this type will usually show the least cost per vehicle-mile.

WHAT ROADS REALLY COST

A table showing the annual cost and curves for the cost per vehicle-mile of several different types of roads have been prepared and are reproduced herewith. The construction and maintenance costs represent average values from the experience of the Michigan State Highway Department during the past two years, with small amounts added to provide for future betterments. Money is taken as worth 5 per cent. The sinking fund earns 3 per cent, and since most of the roads of Michigan are built with money derived from direct taxation rather than from bond issues it is assumed that the funds will be used for rebuilding or resurfacing as follows: Gravel and waterbound macadam roads resurfaced at the end of 5 years for one-half the original cost; bituminous macadam resurfaced at the end of 10 years for one-half the original cost; concrete resurfaced with bituminous concrete or otherwise rebuilt at the end of 15 years at a cost of $10,000 per mile; brick rebuilt at the end of 25 years at a cost of $18,000 per mile.

The curves for the cost per vehicle-mile are discontinued at the points shown because experience has proved that in general the type would not be satisfactory beyond the traffic limits shown. Thus the limit of a 9-ft. gravel road is 200 vehicles per day, that of a 16-ft. gravel road, 500 vehicles per day, etc. In case a road should be constructed or is serving for a greater number of vehicles per day than the limits given, the maintenance would probably cost more than the values assumed. As the upper limit for concrete and brick is approached a 16-ft. road would scarcely be able to care for the traffic, and it might be wise to build an 18-ft. road at a slightly greater cost. Hence the upper portion of the curve for brick is dotted.

CURVES AID SELECTION OF ROAD TYPES

A number of interesting conclusions are apparent from a study of the curves. With the exception of concrete and brick, which cost nearly the same per vehicle-mile because of the probable longer life and lower maintenance cost of the latter, a type of road may be selected which may be expected to serve for an appreciably lower cost than others within certain limits. Concrete, for example, should be able to carry the maximum of heavy travel in Michigan, say 2000 vehicles per day, at 0.20 cent per vehicle-mile. But if it were built for 200 vehicles per day, the cost to the county would be 2 cents for every vehicle that passed over the road. Evidently a 16-ft. gravel road which would carry this traffic for one-half the cost would be far more economical.

It is almost an established fact that untreated waterbound macadam will not stand up any better than gravel under a traffic that is composed largely of automobiles, and, as the curve shows, it is much more expensive. When constructed and maintained with a bituminous carpet, however, the life and the traffic limit are raised, and the cost is lowered. Thus treated, macadam forms an excellent intermediary between gravel and the higher types.

It will be noted that when the traffic is near 200 vehicles per day, the cost of a 16-ft. gravel road is about 0.30 cent higher than that of a 9-ft. gravel road, but the necessity of providing for future increase would make it advisable to construct the former. Similarly, when the traffic is too heavy for gravel and it is necessary to construct surface treated macadam or concrete—the latter being more often built, since the former has not yet attained a wide use in the state—there is a great increase in the cost per vehicle-mile. It is desired of course to reduce this variation and keep the cost as low as possible.

COSTS COMPARED

Reference to the curves show that for the practical limit of a 16-ft. gravel road, 500 vehicles per day, the cost per vehicle-mile is 0.40 cent, and that on a bituminous-surfaced macadam for 800 vehicles per day the cost is the same. The difference between the total annual costs given in the table is $466. Theoretically, therefore, if the traffic does not exceed 800 vehicles per day we could afford to spend $466 plus $150 (the assumed maintenance for the gravel road below 500 vehicles per day), or about $600 per mile per year in the maintenance of the gravel road before it would be economical to build bituminous-surfaced macadam, provided that for that sum the road could be kept in a satisfactory condition. Practically, however, a gravel road carrying 800 vehicles per day would be in a continual state of repair and decidedly unsatisfactory.

Depending on local conditions entirely, the gap between a gravel and a higher-class road may be bridged to a certain extent by paying more for the maintenance. When a county is financially able to build a better road for traffic in excess of 500 vehicles per day it should do so by all means. Without doubt future increase will in time make the road economically suited to the traffic passing over it.

Panama Chain Fenders Tested

On Sept. 4, 1915, the S.S. Luz Blanca, navigating the Panama Canal, approached the lower end of Miraflores locks while the chain fender was up and the semaphore in the danger position. The vessel, according to Major-Gen. Goethals' latest annual report, struck the fender and without appreciably stopping its headway broke the chain. The fact that the machine had been blocked made it impossible for the fender to operate. Nevertheless, the apparent ease with which the vessel went through the chain called attention to the desirability of a working test to determine the effectiveness of the fenders, and a committee was appointed to make a series of experiments upon one of the chain-fender machines at Gatun. Considerable data were obtained, and the results of the tests indicated that the chain-fender machines will operate satisfactorily when properly adjusted and that no difficulty would be encountered in stopping any vessel approaching the locks at a speed under 2 miles per hour. Some minor modifications were made in the apparatus.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Canvas-Covered Timber Coffer Lets Contractor Out Cheaply

THE HIGH COST of steel sheet piling led the contractors for a 150-ft. highway drawbridge over the Obion River near Dyersburg, Tenn., to use Wakefield piles covered with tarpaulin for the 18-ft. circular center-pier cofferdam, thereby saving $1,500. The piles were made from 2 x 10-in. planks 22 ft. long, driven about 7½ ft. below the bottom of the pier. The bearing piles, 35 ft. long, were driven on 3-ft. centers, after the Wakefield piling had been driven and an orange-peel bucket had excavated the caisson 6 ft. below the bed of the river and 13½ ft. below the normal water level.

After the work was under way the county officials, who constituted the inspectors, but were not engineers, insisted on having the caisson pumped dry to see the character of the foundation before concrete was placed on the bearing piles. To accomplish this cheaply the contractor sewed together two strips of tarpaulin 5 ft. wide and 70 ft. long, making a width of 10 ft. The canvas was given two coats of oil and then wrapped on the outside of the piling, leaving about 2 ft. to lay horizontal on the river bed. This lap was weighted down with excavation, making a sufficiently tight seal to permit unwatering the caisson quickly. The total cost of the tarpaulin was $52.

The work was carried out by the Vincennes Bridge Company, for which O. Bundy acted as constructing engineer.

ONCE there was a man who reasoned that if he didn't give anything away, he'd be rich from what he saved.

BUT everybody got on to him. He didn't get anything.

AND there was another fellow who figured he didn't have anything to give.

BUT others had a better sense of values. They stole from him and he didn't even get credit.

HERE'S THE POINT: If we publish your ideas in the Hints for the Contractor section, you'll get pay for them—and credit, too.

Pull Long Piles Down Through Roof to Strengthen Wharf

ALONG the San Francisco waterfront wherever it is necessary to drive piles in a wharf with a shed already upon it a construction scheme has been developed which permits of rapid progress. The piles are lowered through the roof as far as they will go of their own weight, after which they are pulled down by a cable wound on the drum of a small pile driver operating on the floor of the wharf and with leads short enough to pass under the roof truss. When the head of the pile is down to within a few feet of floor level the driver is moved up over the pile and the hammer completes the driving, a follower being used to get it down to a level at which it can be crowded under the cap.

In repairing wharves which require additional piles, the location of each pile is first determined and marked upon the roof. Holes are then cut in the roof, usually about 3 ft. square, as near these locations as roof trusses will permit, or, for a width of 2 or 3 ft., roofing and sheeting may be removed for the full span between two trussed rafters. The piles are rafted to a convenient location alongside the wharf and are picked up by a floating derrick and lowered through the holes in the roof, care being taken to have them enter the mud on such a batter that they can be easily sprung into place under the cap when driven to the proper depth.

On the work shown in the illustrations, the length of piles used was between 60 and 65 ft. The depth of the water was about 20 ft., and the piles usually sank of their own weight until only 15 to 20 ft. remained projecting above the roof. Thus the piles were "driven" for a depth of about 35 ft. by the use of the cable from the winding drum of the driver.

The tackle for pulling down the piles was a snatch block secured to the cap, through which ran the cable from the sheave at the head of the driver leads to another block attached to a short length of cable wrapped around the head of the pile by a helper on the roof. The mud bottom along portions of the San Francisco waterfront is so soft that there is no difficulty in pulling these piles down almost to floor level with the ordinary small driver engine with 8 x 10-in. cylinders.

Just before putting the follower on the pile for final driving, the head is beveled slightly with an adz on the side next to the cap. When the follower has driven it to

BOOM STEPPED IN LEADS PASSES PILES THROUGH ROOF TO SMALL DRIVER UNDER PIERSHED

INSIDE SHED, SMALL DRIVER PULLS PILES DOWN WITHIN REACH OF HAMMER

the proper level the pile usually tends, assisted by the bevel, to spring under the cap. The tightness of the joint can be controlled to a nicety by the amount of bevel and the exact depth to which the pile is driven. The custom is usually to force the new pile under the cap with a fit so tight that the cap will be raised about ⅛ in., or enough to take a considerable portion of the strain on the new pile. When the pile is ready to be sprung under the cap the line from the driver is passed around it and around the far side of the cap, so that tightening up the line forces the new pile into place. Finally, a drift bolt is driven through the cap and into the pile to hold it in place.

One of the pile drivers built by the harbor commission is used as a derrick in this work, a 96-ft. pile boom being stepped between the leads. The large end of the pile is butted against timbers about 24 ft. above the deck of the barge. The pile is then raised and lowered as a derrick boom by a line to its smaller end passing over the sheave at the head of the leads. Of course this rig does not permit of swinging the boom, but as the barge itself can be quickly turned by shore lines, the same result is accomplished, and the crew can pick up the floating piles and drop them through the holes in the roof.

The work on the San Francisco harbor front is under the direction of the Board of State Harbor Commissioners, of which Frank G. White is chief engineer.

Four Men Hoist Forms for Large Building with Hinged Traveler on Casters

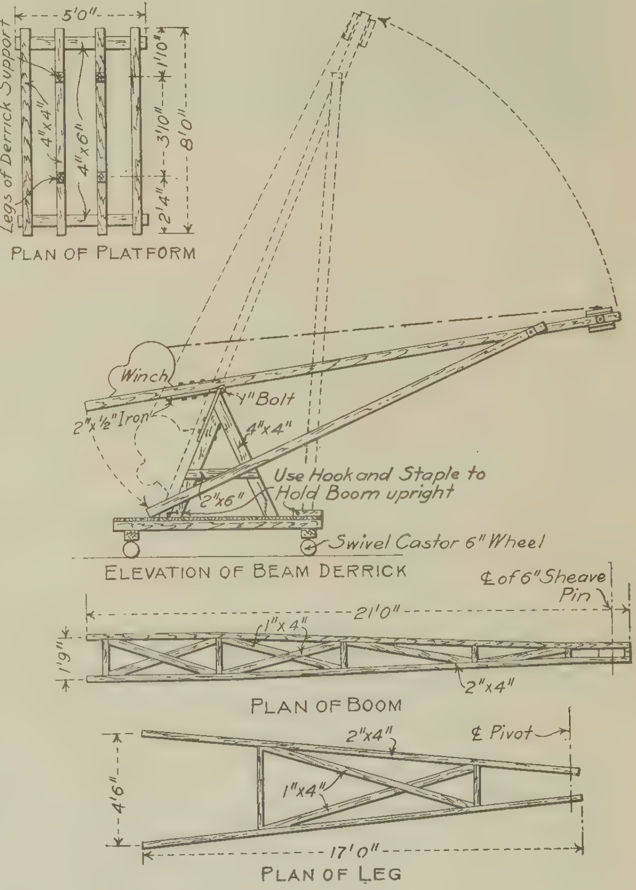
ONE OF THE TRAVELERS shown in the illustration, operated with a hand crab by four men, handled all the forms from each floor level to the next for each unit on the large reinforced-concrete building in Hoboken, N. J., the construction of which is described on page 171 of this issue.

The traveler, as shown in the accompanying sketch, consisted of a framed boom of light timbers hinged near its lower end on a long bolt passing through the top of a low frame built on a square timber platform mounted on four large casters. The crab was set on the lower end of this boom at such a distance below the hinge as to balance the boom almost perfectly. The boom was held in position when raised by two planks, hinged to it near its upper end, and footed on the forward corners of the platform.

In use, the rig would be set in an elevator shaft or at the edge of a completed section of the floor above. As the forms were stripped, the panels would be carried short distances and piled under the end of the boom.

Two men hooked them on to these piles as they were made and hoisted them to the level above, where two other men landed them. It frequently happened that before all the forms were stripped which it was desirable to hoist at a given point, the work had progressed until the traveler was standing, surrounded by concreted formwork, in a hole temporarily left in the floor above. It was for this reason that the boom was hinged. This only made it necessary to leave a sufficient opening in the forms of the upper floor to permit swinging the boom down to a horizontal position. The traveler could then be rolled along the floor below by the two men at that level to the next point where it was wanted.

The device was used by the contractors for the building mentioned, the Turner Construction Company, for whom the work was carried out by Albert Larsen, superintendent.

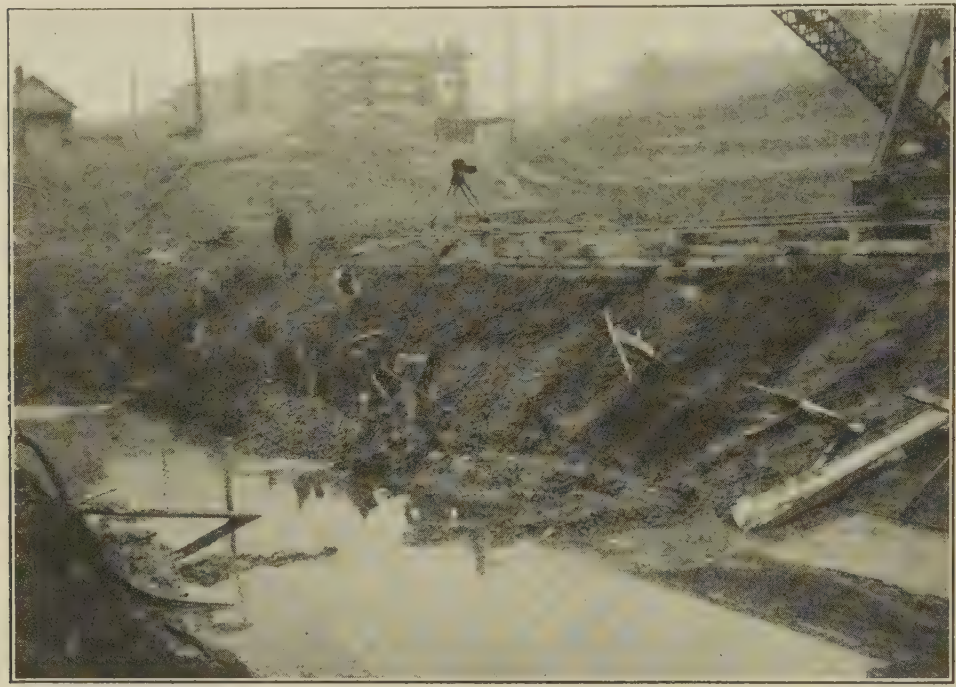


BOOM OF LIGHT TRAVELER FOR HOISTING FORMS RAISED AND LOWERED THROUGH HOLES IN FLOOR ABOVE

Concrete Lining of Channel Bed Flooded to Protect It from Freezing

By ALBERT S. FRY
Memphis, Tenn.

THE PHOTOGRAPH shows conditions which made it easy for the Koehler Brothers-Fowler Construction Company, of Memphis, to protect from frost concrete laid in the floor of a drainage channel in that city by flooding it at night with water. The slab shown, which had set long enough not to be injured by flooding it, is part of the curved-slab lining placed in the bottom of Gayoso Bayou. At the time it was placed the temperature was above freezing during the day time but fell at night to 10 deg. above zero. The waters of the Bayou were diverted around this part of the work, and water was kept out of the section being concreted by a low earth barrier at its end. When it was known that the temperature would drop to a low point during the night, it was a simple matter to cut the earth barrier, open up the dam which diverted the Bayou and flood the concrete to a sufficient depth to protect it.



CURVED CONCRETE SLAB, LAID ON BOTTOM OF CHANNEL, PROTECTED BY FLOODING DURING SEVERE COLD SNAP

The work is part of the project being carried out by the city of Memphis to afford protection against Mississippi River overflows.

Old Touring Car, Rigged to Haul Trailer on Road Contract, Does Work of Four Teams

By J. C. BENTLEY
Engineer and Contractor, Elizabeth, N. J.

THE TRACTOR and trailer illustrated herewith was used on the concrete-road job in Lakewood, N. J., described on page 184. It consisted of a 1910 Thomas touring car with a 40-hp. motor and a 2-yd. Eagle dump wagon.

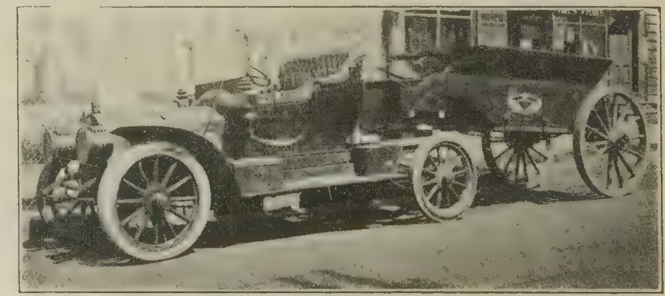
The touring car was remodeled as follows: Four-inch solid tires replaced pneumatic tires upon rear wheels; two additional leaves were added to each rear spring; gears upon the jack shaft were reduced and a fifth wheel was placed upon the chassis over the rear axle. This originally was the entire cradle from the front axle of the dump wagon, but was later replaced by a small cast-iron rocker, which the kingpin of the dumper engaged. With this arrangement there was more flexibility between the two units. The trailer was the standard 2-yd. dumper, and compression cups were installed on the hub of the wheels to insure proper lubrication.

Stone, sand, cement and excavated material were hauled by this unit. The average load was 5000 lb., but when hauling cement, 70 to 75 bags, or 7000 bbl., was frequently hauled. The total dead weight of the outfit was 5300 lb. Of this the front axle carried 1900 lb., the rear axle (tractor) 2400 lb., and the trailer axle 1000 lb. When loaded with 7000 lb. the live load was distributed as follows: Front axle, 200 lb.; rear axle, 2000 lb., and trailer axle, 4800 lb.

The operating speed was about 12 miles per hour and the gasoline consumption about 1 gal. every 8 miles. No daily record was kept other than to keep track of the number of loads hauled from time to time. One of these records showed twenty-eight 2-yd. loads of stone hauled and dumped ½ mile from the car-unloading point in four hours. Stone was unloaded through a trestle and only 45 to 60 seconds were required to obtain a load. Teams at the same time made 12 to 14 trips each with 1½-yd. loads.

On good hard roads this outfit worked very well, doing the work of three and four teams, depending on the haul. Care had to be exercised whenever the full power of the motor was required because of the light rear construction of the tractor. Several parts were broken until the working limit was discovered.

Everything considered, the experiment proved very satisfactory and has convinced the writer that a small-capacity truck with a properly constructed trailer will be of more service on small highway contracts than the larger trucks which he at one time operated.



TOURING CAR CONVERTED INTO TRACTOR

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Foreign Trade Discussed in Pittsburgh

Leading Business Men from Every Section in Attendance

Co-operation was the dominant note of the Fourth National Foreign Trade Convention which met in Pittsburgh last week. It was sounded in every general meeting and every group session. Finally it was crystallized in the report of the National Foreign Trade Council on the Webb Bill, where it was pointed out that the nations of Europe have developed their foreign trade co-operatively and are planning still more extensive and intensive co-operation after the war. The German Government's co-operation with her manufacturers is proverbial. Now England and her colonies are planning an economic alliance, while similar broad plans are in the making as between the Entente Allies, on the one hand, and the Central Powers on the other. Moreover, it is certain that Germany at least, and probably France and England, will arrange to buy co-operatively in the United States after the war is over. Only in the United States are individual companies left to stand alone in the development of foreign trade. This individualistic procedure must give way to co-operation if we are to win and keep such a share of foreign trade as will introduce a shock-absorbing diversity factor into our economic affairs.

Aside from this dominant note of co-operation, the main points emphasized were the dependence of foreign trade on foreign investment, on banking facilities, on a sound shipping policy.

Group Sessions

Of the group sessions—covering foreign credits, co-operation in foreign trade, banking and investment, education for foreign trade, function of the export commission house and the problems of the smaller manufacturer and merchant—the latter, by far, was the most popular. Practically every problem of foreign trade expansion that confronts the smaller manufacturer and merchant when he desires to sell overseas had been covered in advance by a series of questions and answers, available to the convention in pamphlet form. These questions and answers gave the text for the contribution of a great variety and volume of valuable experiences of the manufacturers and merchants present. So keen was the interest that instead of the one session of this group that had been planned, four were necessary to dispose of the questions and problems raised.

Of individual papers, it is possible to take notice of only a few. Willard

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S. T. Henry

An Appreciation by E. J. Mehren, Editor, Engineering Record

S. T. Henry has resigned as second vice-president of the McGraw Publishing Company Inc., and on Feb. 1 became identified with the American International Corporation, New York, as vice-president of a subsidiary organization which will handle the export of contractors' machinery and equipment. Details regarding the new company will be found elsewhere in this section.

Copyright Underwood & Underwood

S. T. HENRY

In his comparatively brief career with the McGraw Publishing Company Henry has made remarkable progress. Entering the organization, fresh from college, in August, 1904, as an assistant on the editorial staff of the Engineering Record, he rose rapidly through the positions of western editor, Cleveland advertising representative, and western manager of the paper to the junior vice-presidency of the company. Since his promotion to a general executive position, his duties have pertained to all the properties of the company, including, in addition to the Engineering Record, the *Electrical World*, the *Electric Railway Journal* and *Metallurgical & Chemical Engineering* and *Electrical Merchandising*.

His rapid rise and his present step to a position of very great responsibility are not only a source of gratification to his many friends, but should

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Debate First Tentative Valuations at Washington

First Two Days of Hearing Develop Interesting Problems—Does Not Reach Largest Issues

None of the really big questions were taken up in detail in the first two days of the hearing in Washington this week, beginning Monday, before the Interstate Commerce Commission relative to the tentative valuations of the Atlanta, Birmingham & Atlantic Railway and the Texas Midland Railroad. The impossibility, however, of separating the minor questions from the fundamental principles of valuation was indicated by the numerous digressions to such principles. As had been expected, the carriers disagreed with almost every feature of the reports, while on the other hand the state commissions in some instances thought the Division of Valuation had been too liberal. The attendance was greater than at any of the previous valuation hearings.

Parties to the Proceedings

The proceedings were conducted by the commission—the carriers, the state commissions, the Division of Valuation and any other interested parties in turn expressing their views on various predetermined issues. The chief representatives were W. G. Brantley and Pierce Butler for the Atlanta, Birmingham & Atlantic (referred to as the A. B. & A) and the Texas Midland respectively; Thomas W. Hulme, for the Presidents' Conference Committee, C. B. Aitchison, for the state commissions, and Charles A. Prouty, director of valuation, and P. J. Farrell, for the Division of Valuation. Among the other representatives was one for the four railway brotherhoods.

The issues were based on the A. B. & A. report, that road being much the larger of the two. Twenty issues not involving the taking of testimony were listed, together with twenty-one involving general principles on which testimony should be taken. Ten of the first group were disposed of in the first two days. In many of the issues the Texas Midland took no part.

General Points Raised

Before the taking up of the separate issues several general points were raised. Mr. Hulme urged the commission to realize that the problems of the large roads were not presented by these small roads. Mr. Brantley and Mr. Butler presented similar motions, which were not sustained, that the proceedings be abandoned until complete valuations in proper form had been made. Each gave a long list of particulars. Director Prouty held, however, that only by presentation and discussion of such tentative valuations could the Division of Valuation know the carriers' objections to its figures.

One point of general practice in which there was sharp disagreement was the extent to which the division had admitted the carriers into its confidence. Mr. Brantley held that it had been done only to a limited extent. Director Prouty mentioned the insistence by the government that the carrier be represented in the field, the making of duplicate notes, and the invitation to the carrier to watch the computations. Only in the fixing of unit prices and the treatment of land had the division decided it could not co-operate. Mr. Brantley insisted, however, that this was co-operation only as to the bare bones of the property.

Clearing and Grubbing

Clearing and grubbing was the first issue. The division had declared that the present-day conditions as to forests of the land adjoining the right-of-way should govern, being the only ones free from speculation. Mr. Brantley held that original historical conditions should be assumed, as the only ones free from speculation, admitting, however, that he would gladly accept the other view if applied as well to built-up districts, where, he said, the principle would demand the purchase and razing of assumed buildings. Director Prouty would not admit the possibility of a correct guess as to the buildings that would be encountered. C. E. Elmquist for the state commissions said that both views as to clearing and grubbing involved assumptions; that in reproduction there would be no clearing or grubbing, and none should be allowed.

Joint Property

On the second issue, property jointly used, Mr. Butler took exception to the division's course. He held that in excluding the Texas Midland's two terminals and 14 miles of its main line in the middle, just because these were not owned by the Texas Midland, the road was rendered incapable of public service. He held that all carrier property used but not owned should appear in reproduction cost, with the facts explained. Director Prouty said reference alone to such property was enough. The division was unwilling, he said, to duplicate the property, and to keep the cost of inventory within reason it was necessary to deal with each carrier's own property when that carrier was under valuation.

What Mr. Brantley called the reverse of this case was brought up by the third issue—telegraph line along the A. B. & A. The latter road claimed to have built this line and to have permitted the Western Union, by a contract, to take over the line and add wires, the A. B & A. retaining two wires exclusively, however, and having preferential rights over others. No allowance was made in the tentative valuation, however, and the railroad was the loser. This question was deferred pending a statement from the Western Union regarding the facts of ownership.

Property Owned But Not Used

Another phase of the general question of divided ownership or use was raised by the fourth issue—track leased to the Woodward Iron Company. According to Mr. Brantley, the A. B. & A. had started a 14-mi. line and abandoned it, had (while in receivership) been ordered by the courts to complete it, had operated it two or three years at a loss, owing to stagnation of the territory served, and had then leased it for a nominal rental to the Woodward Iron Company, reserving the right to operate over the entire line, but in fact using only 2 miles. He thought the company ought not to be penalized for having made a bargain eliminating a loss, and thought the court's order to complete the road sufficient answer to Mr. Aitchison's proposal that this be simply classed as an unfortunate venture. The division excluded this from its summary of reproduction cost, while the carrier claimed it. The division's answer was that on the date of valuation it was not in use for common-carrier purposes, the Atlanta Terminal Company, of which the A. B. & A. was lessee, and not the A. B. & A. itself, being owner of the line in question.

Form of Report

The next six issues were discussed in two groups, one having to do with liquid assets—working capital, materials and supplies and current assets—the other with donations to predecessor companies, and deeds upon nominal consideration. Perhaps more important than anything brought out on these points was the general question that repeatedly came up—the form of the tentative valuations, and what they included. Mr. Butler thought that as presented they excluded all the supporting data in the supplementary land, engineering and accounting reports, and following the signature in the main report. On that basis he thought none of the tentative valuation, if made final, would be acceptable as prima facie evidence. Mr. Farrell thought it clear enough that the whole report was to be taken together. The question of the proper form of the report, and whether there shall be an ultimate finding of value, is one, however, in which there is apparently some doubt, both among the representatives of the Division of Valuation and among those of the carriers.

Highway Courses at University of Kentucky February 5 to 10

Short courses in highway engineering will be held Feb. 5 to 10 at the University of Kentucky. During the last three years the attendance at these courses has increased from 50 to more than 200. It is expected that this year's enrolment will exceed past records. The instruction is directed by the highway engineering department of the university, of which Prof. D. V. Terrell has charge.

Foreign Trade Discussed in Pittsburgh

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Straight, vice-president of the American International Corporation, New York, made a strong plea for the adoption of a bargaining tariff. C. K. McIntosh, vice-president of the Bank of California, San Francisco, argued for extensive educational work which would impress upon everybody "from the chief magistrate to the humblest citizen" that individual prosperity is inseparably bound up with foreign trade and general industrial conditions. The subject of foreign loans here during the war period was taken up by Festus J. Wade, president of the Mercantile Trust Company, St. Louis. He declared it his belief that every dollar of obligations contracted here during the war would be paid and that there need be no fear whatsoever of repudiation. If the foreign nations were to repudiate these obligations, trade between those countries and the United States would necessarily stop, a result that would be disastrous to the European nations, particularly under the conditions which will obtain at the close of the war.

Reports Presented

Among the stimulating and valuable reports presented were the following: Industrial reconstruction in Europe, examples of American export enterprise, suggested methods of co-operation in foreign trade, the Webb Bill, world shipping conditions and the American merchant marine; world trade conditions after the European war.

The sentiment of the convention, as a whole, was summed up in the report of the General Convention Committee. As has been customary in the past, no resolutions were presented. The committee merely reported what it considered to be the consensus of the convention, as developed in the papers and discussions.

It pointed out that the development of our foreign trade depends upon our resources, on our enterprise and on the education of a body of young men fitted for the demands of foreign trade and anxious to participate therein. It depends further on the participation of a large number of moderate-sized firms. The government, the report stated, can help in many directions—by making suitable commercial treaties, by collecting from abroad and disseminating here information regarding foreign requirements, by permitting co-operation, etc. —but in the last analysis our success will depend upon the initiative and ability of our merchants.

Should Pass Webb Bill

The greater part of the report, which was, however, brief, was devoted to those matters of a legislative character which now press for solution. The need for the prompt passage of the Webb Bill was again emphasized, while the necessity of a sound shipping policy, of straightening out the treaty situation, which has been turned topsy-turvy by the war, and of a flexible tariff, was discussed in some detail.

Finally, it was pointed out that many different departments of the government need to co-operate in order that every facility may be offered for foreign-trade expansion. The legislative features have been emphasized above, but the Department of State, the Department of Commerce, the Federal Trade Commission, the Shipping Board, the Federal Reserve Board and the Tariff Commission (soon to be appointed) all have certain functions with a more or less direct bearing on export trade.

New York Central Railroad Plans $20,000,000 Cutoff

A reduction of two to five days on freight shipments between New York, New England, and the West, together with relief of freight congestion at various points and provision for growth of commerce for many years, is the promised result of the so-called "Castleton cutoff" improvement of the New York Central Railroad. After ten years of planning the road has reached the point of readiness for construction work. Official announcement was made of the plans in an address made this week by H. Leroy Austin of Albany, counsel for the New York Central.

The new cutoff, 20 miles long, will double the freight capacity of the New York Central and nearly double the passenger capacity. The bridge to be thrown across the Hudson two miles south of Castleton, which will cost $5,000,000, must be completed by 1920. The whole project involves the expenditure of $20,000,000.

Engineers' Status in Ohio Needs Correcting

Concerted effort on the part of engineers in Ohio to effect a revision of laws which will dignify their professional services so as to make unnecessary a public letting to the lowest and best bidder was called for at the Ohio Engineering Society meeting Feb. 1 by W. J. Sherman.

The status of the engineer practising in Ohio is briefly reviewed as follows: In the opinion of many solicitors he cannot be engaged at a fee in excess of $500 without a public advertisement and an award to the lowest and best bidder. A lawful contract cannot be entered into for his services unless it is certified that there is money enough in the fund that has not been otherwise appropriated. In many, and perhaps most, instances there is no money in the fund and cannot be until the bonds have been sold. Bonds cannot be sold until plans have been adopted and estimates approved. The services of an engineer are required before the plans and estimates can be submitted, and even though money be in the fund when the service contract is executed, it is likely to be transferred to the general fund at the end of the calendar year.

S. T. Henry

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be an inspiration to all the younger readers of the Engineering Record. He came to the McGraw Publishing Company inexperienced in publishing work and unknown to the organization. Yet so well did he perform his appointed tasks that in 10 years he had run the gamut of positions on the Engineering Record and had been graduated to an executive post in one of the great technical publishing organizations of the country. Now, at the age of 35, with a matured judgment, born of the responsibilities he has had to carry, he steps into a still broader field—one in which his influence can, and undoubtedly will, be felt internationally.

Reasons for His Success

Those who know Henry intimately will not need to be told the characteristics that have brought him such singular success. No one can meet him without catching his enthusiasm; no one ever put a difficulty before him without finding a sympathetic response and receiving any assistance which lay in his power. These qualities, combined with exceptional mental alertness, great capacity for work and ability to sense the big possibilities of plans, have made him a marked man in every circle in which he has moved.

Of course—and this is said to the younger men—his success did not come automatically. While endowed with exceptional abilities, he has made effective use of them by doing a prodigious amount of work and by never shunning new responsibilities.

He has always attached great importance to his physical condition—due to his experience as a member of the track team in college. These physical precautions may appear, to the average young man, to be trivialities, but they are the foundation on which Henry's exuberant good health is built, and this good health, in turn, is reflected in his clear-headedness and his enthusiasm. He himself, we have no doubt, would attribute much of his success, indirectly, to be sure, but no less certainly, to his physical vigor.

Outside Relations

The enthusiasm that he has displayed in his business connections has been manifest, too, in his outside relations. No organization to which he ever gave time but profited by his counsel, his vision, and his energy. In the trade and technical publishing field he is as well and favorably known as among the readers and advertisers of the Engineering Record.

Among the alumni of the University of Illinois, his Alma Mater, likewise, his acquaintance is very large. He organized local alumni associations in New York and Cleveland and was instrumental in putting the Chicago association on a better basis. The university, in turn, has shown its appreciation of his ability by repeatedly asking him to lecture before both the engineering and the general student bodies. He has never failed on these occasions to put into his talks the enthusiasm and optimism that have made his words remembered long after those of older, but less magnetic, participants in the programs were forgotten. His university did much for him and, like a loyal son, he never fails in his duty, when occasion permits, of repaying the debt.

In his new responsibilities he will be able to make good use of the experience gained on the editorial and advertising staffs of the Engineering Record. His function will be to promote the sale abroad of American contracting equipment and machinery—a field that he probably knows better than any man in the country. For 10 years, as editorial and advertising representative of the Engineering Record, he was brought in close contact with the users and the manufacturers of such machinery and equipment, and with his engineering training as a background he acquired an exceptional grasp of the uses and economics of the various types. In addition to acquiring a knowledge of the equipment itself, he built up that broad acquaintance in the field without which singular success in a work of the magnitude of that he is now undertaking would be impossible. He goes to his new position, therefore, exceptionally well prepared for its responsibilities.

The best wishes of his associates in the McGraw Publishing Company and of his host of friends in the engineering and contracting fields go with him in his new work.

Asks Receiver for Everglades Drainage Funds

Misuse of Funds, Illegal Operations and Bad Faith on Part of State Charged in Suit Filed

An order restraining the Internal Improvement Board which has charge of drainage operations in the Florida Everglades from continuing its work and for the appointment of a receiver for the internal-improvement funds has been asked for in a suit filed in Jacksonville, Fla. The bill claims that nearly 2,000,000 acres of the Everglades lands have been illegally given to railroads and other corporations, that nearly $2,000,000 of the state's trust funds have been illegally diverted and that the Board of Internal Improvement Trustees has used illegal methods in handling the Everglades drainage proposition. The bill further charges that the whole situation is in a bad muddle and cannot under such supervision ever be brought to a successful conclusion.

Bad faith on the part of the state in the conduct of the Everglades drainage is alleged in the suit, and it is claimed that the present bond issue of $3,500,000 would not be sufficient to carry on any drainage work after the outstanding debts of the board have been paid. The bill further sets forth that it will require fully $40,000,000 to complete the work.

Wood Preservers' Association Meets in New York

Adopts Specifications for Treating Paving Blocks and for Various Preservatives—More Publicity Urged

Specifications for the treatment of wood paving blocks, agreed upon at a meeting of representatives of various technical associations in Brooklyn last September, and adopted by the American Society of Municipal Improvements in October at the Newark meeting, were adopted last week with minor changes by the American Wood Preservers' Association at its thirteenth annual meeting in New York City. Specifications were also adopted for various common preservatives, as were rules for the purchase and preservation of treatable timber and definitions of the principal preservative processes. Vigorous appeals were made to the society to give timber and its possibilities when treated more and better publicity, which would match that given concrete and other rival materials. It was asked that the society be less fearful of boosting competitors within the timber or preservative field, when giving publicity. Lantern slides illustrated why treatment sometimes fails to prevent decay.

About 100 members and 100 guests registered for the meeting, at which C. G. Crawford, president, presided. F. J. Angier, secretary-treasurer, reported a membership of 300, a gain of 24.

E. A Sterling, chairman of the committee on publicity, made an ardent appeal along the lines set forth in a preceding paragraph. Later in the convention J. H. Waterman and George E. Rex presented lantern slides showing how ties and other timber have failed, though treated, because of incipient decay induced by improper handling before treatment. Examples of storing on end, and of seasoning in large puddles of water were shown and condemned. It was urged that the abuses as well as the uses of treatment be called to the attention of timber users.

Debate on Specifications

The chief debate of the convention was on the subject of specifications offered for various preservatives which are in common use. Efforts were made by one or two members to induce the association to commit itself as to the relative merits of different preservatives. The committee itself refrained from recommending water-gas tar specifications for paving blocks, prepared by one of the subcommittees. These were adopted by the convention, however, and the only finding reflecting on the relative merits of materials was the qualifying clause adopted some time ago by the American Railway Engineering Association, to the effect that creosote coal-tar solution is recommended only when creosote is not available. The specifications adopted include zinc chloride, both creosote and creosote-coal tar solution for ties and structural timber, and coal-tar oil, distillate oil and water-gas tar for paving blocks.

Objection was raised to the steaming of the blocks, in the specifications of the wood-block paving committee. It was held that the expense was unnecessary, and that the blocks were weakened thereby. Answer was made that steaming prevents bleeding and reduces expansion, and does no harm if the temperature is kept below 240 deg. Fahr.

The specifications were adopted with minor changes. They provide among other things that air-seasoned and green timber should not be treated in the same charge; that both classes should be steamed from 2 to 4 hours at from 220 to 240 deg. Fahr. and held under a vacuum of at least 22 in. for one hour, this to equalize the moisture content, swell the dry cells, and extract the excess water. This will produce even treatment through heart and sapwood with no excess in either, prevent excessive expansion and reduce bleeding. Bleeding will be further reduced by final steaming and vacuum treatment. The blocks should be thoroughly sprinkled in the street before laying.

Other conclusions adopted include rules for the purchase and preservation of treatable timber and definitions of the principal preservative processes. Plant operation was reported on, as were service tests and ties and structural timber, and wood-block paving. A paper by C. P. Winslow on the grouping of ties for treatment was read.

New Officers

Officers for the coming year were elected as follows: President, John Foley, forester, Pennsylvania Railroad; first vice-president, M. K. Trumbull, vice-president, National Lumber & Creosoting Company; second vice-president, J. B. Card, president, Central Creosoting Company; secretary-treasurer, F. J. Angier, superintendent of timber-treating plants, Baltimore & Ohio Railroad; members of executive committee, V. K. Hendricks and C. M. Taylor. The next annual meeting will be held in Chicago.

Improvements Advocated for New Jersey Highways

Without specifying any particular method of raising funds for a state highway system, the County Engineers' Association of New Jersey, meeting at Trenton, Jan. 16, advocated widespread road improvements in the state, made in a systematic manner. Papers having to do with road conditions and engineering problems were read, as well as the final report of the special committee on the regulation of commercial motor vehicles. Bills based on the recommendation of the report will be presented early in the present term of the legislature. It is understood that the provision in the report calling for sealed governors is retained, but will not affect present equipment.

Officers elected for the present year are: President, Jacob L. Bauer; vice-president, James Logan; secretary, Robert Ferguson, Passaic, N. J.; treasurer, Alvin B. Fox.

San Francisco Incinerator Suit Decided

Federal District Court Awards $160,000 Judgment to Destructor Company —Case Will Be Appealed

The suit to recover $160,000 from the city of San Francisco for the construction of the Islais Creek incinerator and a portion of the equipment of the North Beach incinerator was decided on Jan. 18 in favor of the Destructor Company in Judge Van Fleet's department of the Federal District Court. M. M. O'Shaughnessy, city engineer of San Francisco, states that an immediate appeal from the decision will be made and the case will be carried, if necessary, to the highest tribunal.

Ordered Work Discontinued

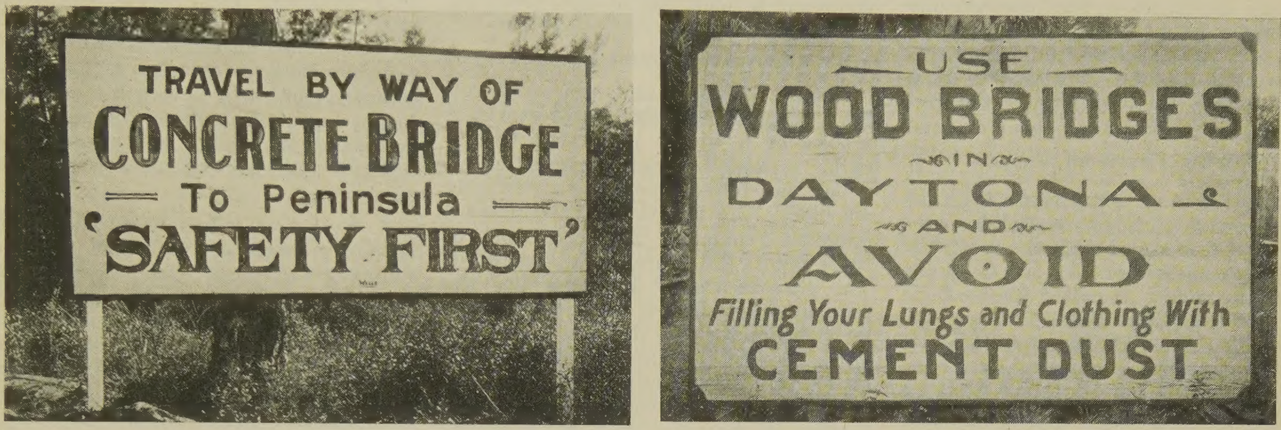
Shortly after work on the Islais Creek incinerator was under way, Mr. O'Shaughnessy became city engineer. He examined similar incinerating plants in the East, and came to the conclusion that the 50 per cent moisture content of San Francisco garbage would make it difficult for the Destructor Company to comply with the specifications. Accordingly, he ordered work on the North Beach plant discontinued until such time as the Islais Creek incinerator could be tested.

The Islais Creek plant was finished and subjected to tests in September and October, 1914, and was then rejected by the city engineer because it did not comply with the specifications. Nuisance was created in its operation, he stated, and obnoxious odors, smoke and dust escaped from the building or the chimney. A report of the tests appeared on page 12 of the Engineering Record for July 4, 1914.

Case Will Be Appealed

On the day following the decision, Mr. O'Shaughnessy said to a representative of the Engineering Record in San Francisco:

"The case will be appealed immediately. According to my understanding of the specifications, the city was to receive a plant that could be operated without nuisance. The Islais Creek incinerator as at present constructed cannot incinerate garbage without producing offensive smoke, dust and odor, and I disagree with the verdict rendered. Many witnesses testified during the trial as to the smoke, dust and odor that emanated from the plant. Mr. King, secretary of the chamber of commerce, stated that he had been actively in touch with the tests and that he did not consider that the incinerator complied with what he had been led to believe the city would receive. Mr. King stated that, aside from the specifications, E. H. Foster, vice-president of the Destructor Company, gave assurance on many occasions that the Islais Creek plant could be operated without nuisance features, which guarantee, in his opinion, was far from being fulfilled."



Owners of Toll Bridges Adopt Unique Methods to Secure Business

IN an effort to divert traffic over their respective structures, two owners of toll bridges have erected the signs shown at a point where travelers have a choice of routes. The roads over the different bridges lead to practically the same point—hence the competition for the bridge fee, which is 25 cents either way.

Engineers Hold Three-Day Convention at Chicago

A three-day convention during "Cement Show Week" at Chicago has been planned by the American Association of Engineers. This is the second annual convention of the organization.

Beginning Feb. 8, at 10 a. m., papers on accountancy and the engineer and engineers as city managers will be presented. A proposed plan for national promotion will be explained by A. H. Krom, general manager of the American Association of Engineers. Thursday afternoon has been set aside to allow inspection of the Cement Show, and that evening the association plans to attend the engineering session of the American Concrete Institute.

Friday morning will be devoted to an inspection trip to the new municipal pier, Field Museum, Lake View pumping station and other points of engineering interest. In the afternoon the members will visit the Buffington works of the Universal Portland Cement Company. An informal smoker is planned for that evening.

The tentative program for Saturday includes papers on civil service and the engineer, qualifications for engineers and engineering ethics. The banquet will be held at 6.30 p. m. at the Hotel La Salle.

Form Terminal Engineers' Club

The Society of Terminal Engineers has just been chartered to promote the study of terminal engineering and mechanical freight handling as a specialty.

The organization has three grades of membership—member, associate and junior. The member grade is open to professors of civil and mechanical engineering and engineers specializing in terminal work. Associate membership applies to officers and others connected with concerns manufacturing freight-handling appliances and terminal equipment and those whose work and interests enable them to co-operate in the aims of the society. Junior members comprise young engineers and recent graduates who will specialize in terminal engineering.

The partial organization so far effected is: President, H. McL. Harding, New York; vice-presidents, General W. H. Bixby, U. S. A., Washington, and John Meigs, Philadelphia; treasurer, W. J. Barney, New York; secretary, J. Leonard, New York.

The office of the secretary is at 1133 Broadway, New York City.

Last Span Is Placed on Columbia River Bridge

The last span of the Columbia River interstate bridge was recently launched and successfully fitted into place. This completes the difficult construction features of the first highway bridge to be thrown across the lower Columbia River. A complete description of the design and construction methods appeared in Engineering Record, July 8, 1916, page 36.

Greatest care attended the placing of the last span, as there was practically no leeway, this span being fitted in between others already anchored in final position. The time required to place the span, however, was less than on any of those previously put into position, only 30 minutes elapsing between the time the span left shore and its location in final position.

All of the spans were built on the north bank of the river just downstream from the bridge site, so that when ready to be placed in position two stern-wheel steamers could push the supporting barges upstream until the span was in proper position above pier supports. Electric-railway tracks are being laid to connect with the trestle across Hayden Island already built by the Portland Railway, Light & Power Company. The paving of the bridge is already under way.

Cleveland Society Asks Council for Paving Commission

To work out a definite constructive paving plan in expending the $3,000,000 paving bonds voted last fall, which is the city's share of approximately $10,000,000 worth of paving, the Cleveland Engineering Society Jan. 18 asked the mayor and city council to appoint a paving commission. It would have authority to make rules under which paving and repaving would be done, and to determine the policy to be pursued in the laying of pavements before or after sewers, gas pipes, telephone tunnels and water mains are placed; also to outline a definite policy in regard to the construction of curb connections, and as to the replacement after the pavements are torn up by public utilities. It is suggested that the commission consist of three paid expert paving engineers giving a portion of their time to the city, or that the commission be made up of citizens serving without pay, the majority to be engineers. In both cases the commission would work in conjunction with the city engineer. On account of the large amount of work proposed the society recommends that the city engineer have as one of his assistants a thoroughly trained and experienced expert paving engineer.

THIS WEEK
Prices of construction materials—Review of conditions indicates increased building activity.
See First Page of Contracting News.

Illinois Society Discusses Professional Ethics

Attention Given to Professional Problems at Annual Meeting in Chicago

A constitutional change providing for sections with halved dues and non-technical membership requirements, as outlined in the address of the president, Paul Hansen, was the most important thing accomplished at the thirty-second annual meeting of the Illinois Society of Engineers held Jan. 25 and 26 in the rooms of the Western Society of Engineers in Chicago. The liveliest discussions related to ethical, material welfare and professional unity subjects, rather than to the twenty-three technical papers and reports on the program.

Baker Pavement Report

For more than thirty hours the committee on resolutions, headed by John W. Alvord, wrestled with the matter of the investigation of the Ira O. Baker pavement report as called for by C. D. Hill of the Chicago Board of Local Improvements; but its recommendation to have the question considered by a committee consisting of Professor Baker, a member of the board, and a third disinterested inquirer was not accepted. The whole proposition finally was placed in the hands of the executive board.

The principle of the consolidation and readjustment of state departments now under consideration in the state legislature was concurred in and the legislative committee was authorized to urge the governor to recognize engineers in making appointments to the departments having to do with engineering.

Prof. F. H. Newell, in his address on "Co-operation in Engineering," sounded an apparently popular note, for it was referred to frequently at each of the succeeding meetings. Co-operation for legislation, publicity, employment and ethics were the lines he emphasized (see Engineering Record, Jan. 27, page 146).

Fees and Ethics

The committee on fees and ethics, J. W. Dappert, chairman, sent out a questionnaire, but received only fifteen replies. These indicated to C. B. Burdick, who presented the report, that there was not so much dissatisfaction after all. As to ethics, the fundamental basis is the Golden Rule elaborated. College professors were urged not to take smaller fees than their competitors. The question of public officials taking on consulting work was held to be one between the employer and employee only. Nothing definite in regard to fees was proposed. In fact, any definite scale limit was frowned upon.

G. C. Habermeyer, of the State Water Survey, described the experiments on a study of the removal of iron for the well-water supply of Springfield, which has an iron content of 1 to 3.4 parts per million. The process was to remove oxygen by simple pan aërators and to remove the CO$_2$ by lime. Prof. Edward Bartow added the information that experience at Anna and Mount Vernon indicated that manganese would not come out under the same treatment until the sand grain had been coated with manganese dioxide. S. A. Greeley in his committee report on sewerage and sewage disposal discussed the feasibility of having an interim meeting for operators of sewerage systems and sewage-disposal plants. "Operation of a Sewerage System," a paper by M. H. Brightman, city engineer, Elgin, outlined inspection methods and asked for the invention of a simple periscope instrument to look into sewers from the street level.

Sewage-Disposal Plants

M. C. Sjoblom, assistant engineer, State Board of Health, gave startling results of a winter inspection trip to eight sewage-disposal plants, few of which he found operating with any efficiency. He stated that the present haphazard manner in which most of these plants are operated is lamentable. The persons chiefly to blame are the municipal authorities, who are actuated by a desire to keep down expenses, or more often through ignorance. He suggested that engineers who design plants provide framed instructions for the operation of the plant in addition to instructing the proper officials. Retention of the engineer for a year's operation period was also urged.

Roads and Pavements

Road material interests came in for much credit for the rapid development of many phases of construction in the report of B. H. Piepmeier, chairman of the committee on roads and pavements. It is being realized more and more, he stated, that all materials have their places, and that the selection of the type most suitable to the traffic condition is a boost for all concerned. In new methods Mr. Piepmeier noted the bituminizing of soft shale or even clay brick for road construction. Experiments indicate that the softer brick may be made to stand abrasion and is almost on a par with the higher grade shale brick. Answers from forty-five cities indicate that the major number use a 5-in. concrete base with a sand cushion under the brick, and a 4-in. base when the dry-mortar cushion is used. The yardage is equally divided between bituminous, cement and sand fillers.

Professor Talbot supplemented D. A. Abram's remarks on the advantage of getting the proper amount of water in concrete, with data showing materially increased strength in three-year specimens kept in moist sand. S. M. Woodward described the surveys for the flood control in Miami Valley and showed slides of the hydraulic experiments with the model for obtaining standing wave data.

The newly elected officers are as follows: President, W. D. Gerber; vice-president, J. G. Melluish; new trustees, Robert I. Randolph and F. W. De Wolf. Quincy was chosen for the next meeting place.

What Engineers and Contractors Are Doing

T. Russell Howard has accepted the position of resident engineer, Real Estate Development & Construction Corporation, Petersburg, Va.

C. S. Rindsfoos has become associated with the Jarrett-Chambers Company, Inc., engineers and contractors, New York City. Mr. Rindsfoos was secretary and treasurer of the Foundation Company until about two years ago, when he resigned to organize the U. S. Purchasing Corporation. He will continue to be a director of the latter company, but will devote his activities to the Jarrett-Chambers Company, specialists in the design and execution of difficult underground work and industrial plants.

S. E. Stout has been selected as efficiency engineer with the Whiting Foundry Equipment Company, Harvey, Ill. Mr. Stout since his graduation from Purdue in 1910 has had several years' experience in efficiency work with the American Bridge Company and with the Cook County (Illinois) Civil Service Commission.

George L. Kelly, for seven years structural engineer and estimator with the American Construction Company, Houston, Tex., is now with the Heller Brothers Company, general contractor, Houston, in charge of the estimating department.

O. W. Head, who has been connected with the Connecticut State Highway Department as division engineer for nearly four years, has resigned to become secretary of the Robert D. Daly Company of New Haven, Conn. Mr. Head started work as an engineer in April, 1898, with the Boston & Maine Railroad and continued in that capacity until June, 1903, when he became identified with French & Hubbard, Garvins Falls, N. H. Later Mr. Head was employed by the engineering department of the New York, New Haven & Hartford Railroad. When he left that road to assume the position of division engineer with the state highway department he was assistant engineer in charge of construction.

C. P. Dexter, former assistant engineer, King County, Washington, has been engaged to take charge of office work with the Port Angeles & Grays Harbor Railway Company.

C. H. Lawrence has been appointed city engineer of Warren, Ohio. Mr. Lawrence was formerly head of the paving department and now takes the place left vacant by the resignation of H. McKibben.

James S. Shute has resigned as construction engineer with the E. E. Smith Contracting Company, New York City, to accept the position of division engineer, Department of City Transit, City of Philadelphia. Mr.

Shute was engaged on subway work in Philadelphia from 1903 to 1909, spent one year with Board of Water Supply as assistant engineer and was with the Smith Contracting Company for nearly seven years.

JOSEPH E. KUHN, Brigadier-General, U. S. A., has been made president of the War College and assistant to the Chief of Staff. He was recently promoted from the rank of colonel in the Corps of Engineers.

MALCOLM PARLIN has been appointed county engineer of Leavenworth County, Kan. He is a graduate of the University of Kansas and was recently assistant engineer of Leavenworth.

FREDERICK B. HARRIS, civil engineer, U. S. N., Chief of the Bureau of Yards and Docks, has been named by the President as rear-admiral, under the new law which provides for five staff officers of the navy with the rank of rear-admiral. His list rank was lieutenant-commander, but he has had an ex-officio rank of rear-admiral by virtue of his position as chief of bureau.

HOWARD C. PHILLIPS, recent assistant general secretary of the President's Conference Committee on federal valuation of railroads, has been appointed secretary, succeeding Thomas W. Hulme. Mr. Phillips was graduated from Princeton University in 1890. In 1893 he was assistant engineer for the New York, New Haven & Hartford Railroad and was later engaged on track elevation work in Boston. In 1898 he went to New Mexico on location surveys for the Pecos Valley & Northeastern Railroad. He soon joined the engineering corps of the Atchison, Topeko & Santa Fé Railway and was promoted through various grades to the position of chief engineer of the company's coast lines at Los Angeles in 1906. In 1912 he was made valuation engineer of the company with headquarters at Chicago.

THOMAS BENTON HAMILTON has been elected resident vice-president of the Pittsburgh, Cincinnati, Chicago & St. Louis Railway, with headquarters at St. Louis. Mr. Hamilton was graduated from Princeton University in 1888 and entered railway service in the same year as a rodman on the Jeffersonville, Madison and Indianapolis Railroad. From Jan., 1890, to Jan. 1912, he held the positions of assistant engineer, engineer of maintenance of way and division superintendent with several different railroads. On the latter date he was appointed general superintendent of the central system of the Pennsylvania Lines West of Pittsburgh and in Jan., 1914, was promoted to general manager of the Vandalia Railroad Company.

RAMÓN RAMOS CASELLAS, city engineer, Arecibo, Puerto Rico, from 1905 to 1915, and resident engineer Department of the Interior of Puerto Rico to 1916, has been promoted to the position of construction engineer. He will have charge of all bridge and road work under construction by the government of Puerto Rico. Mr. Casellas was graduated from the Institute Provincial de Puerto Rico in 1899 and from the Rensselaer Polytechnic Institute in 1905. Later he introduced concrete pavements in Puerto Rico, building the first street in Arecibo in 1906.

CAPT. G. E. EDGERTON, Corps of Engineers, U. S. A., who has been in charge of the engineering depot, U. S. Army, at El Paso, Tex., since its organization in July, 1916, has been relieved of that duty by Major R. T. Ward, Corps of Engineers. Captain Edgerton is assigned to the Second Regiment of Engineers, in Mexico.

Obituary Notes

RICHARD B. DOLE, of the U. S. Geological Survey, died in Washington, Jan. 21, after a brief illness. He was born May 8, 1880, at Portland, Me. In 1903 he took a graduate course in chemistry at the Massachusetts Institute of Technology, and in June of that year he was appointed engineering aid in the U. S. Geological Survey. At the time of his death he was chemist in the water resources branch. Mr. Dole made sanitary surveys of rivers in Iowa and Indiana, an investigation of the sanitary and mineral quality of the surface waters of Minnesota, a chemical survey of the ground waters of the San Joaquin Valley in California, and a sanitary inspection of Glacier, Yellowstone and Yosemite national parks. He also had charge of a general investigation of the chemical composition of surface waters throughout the United States, as well as supervision in the survey of all matters dealing with the quality of water. In 1909 he was detailed to the State Department and was sent to Ecuador as agent in charge of the U. S. Government exhibits in the National Ecuadoran Exposition. Mr. Dole wrote many reports and papers on the quality of waters, including a chapter on water for industrial purposes in the "Manual of Industrial Chemistry," by Rogers and Aubert.

EUGENE L. HURLEY, assistant to the valuation engineer of the New York Central Railroad, Buffalo and East, died Jan. 6 as the result of an operation. Mr. Hurley was born in Rahway, N. J., Aug. 4, 1875, and was a graduate of Rutgers College. He entered the service of the New York Central & Hudson River Railroad in March, 1900, as assistant engineer, maintenance of way department at Kingston and Weehawken. He was later transferred to Albany and returned to New York in 1905, where he remained until the time of his death. In 1911 he had direct supervision of the forces engaged in the so-called Swain valuation of the railroad east of Buffalo, and in 1913 he joined the present valuation forces. Mr. Hurley resided in Armour Villa Park, Yonkers, N. Y.

Construction Machinery Export Company Organized

The American International Corporation has formed a new subsidiary to introduce throughout the world the labor-saving construction machinery which has been so highly developed in this country. The new organization is to be known as the Allied Construction Machinery Corporation, with its home office in New York City. Branches will shortly be established in various countries where the markets are most promising.

Among the American trade the machinery involved in the plans just announced is known as contractors' plant and equipment. This includes concrete mixing and distributing plants, derricks, air compressors, hoisting engines, power shovels, road-building machinery, trench-digging machines, light railways and similar products. Manufacturers in the United States have more or less unconsciously led the world in the development of such machinery. In fact, much of this class of machinery is not used elsewhere at all.

Markets

Since the war began, some of our high-speed, labor-saving construction machinery has been sold in France, England and Russia. The success of this machinery and of that sold in other parts of the world indicates a broad, immediate market. Moreover, the reconstruction period in Europe is expected to offer an exceptional opportunity.

Larger and more permanent markets are, however, considered to be likely in countries which may be developed in the way the United States has grown. For example, much of virgin South and Central America can be opened up rapidly and most economically only by the use of American construction machinery and methods. The same applies to European Russia.

Although these large market opportunities evidently may be opened up, no single American manufacturer can afford to undertake the promotional and educational work necessary to develop them. In accordance with the basic policy of the American International Corporation, of assisting interests here under such circumstances, the new subsidiary was formed. Arrangements have been made to represent several of the more important non-competing manufacturers of construction machinery, and additional lines are to be taken on later. The many connections and representatives of the parent company will be available in perfecting the new organization.

R. P. Tinsley, secretary and treasurer of the American International Corporation, has been elected president and S. T. Henry, formerly second vice-president of the McGraw Publishing Company, has been elected vice-president and general manager of the Allied Construction Machinery Corporation. An appreciation of Mr. Henry will be found on the first page of this section.

Price Advances Led by Cement and Rope

With Prospects for a Busy Construction Season, Advance Demand Seems to Be Affecting Prices—Freight Situation Still Acute

ALL COMPILATIONS of building statistics agrees that permits issued during last December were unusually heavy for that month. According to one set of statistics, permits were not only heavier than in the same month of 1915, but considerably greater in 20 leading cities than permits issued during any December of this century. The volume of projected factory construction is running fully double previous high records, according to this authority, who concludes that while this class of construction may decline during the year the spring of 1917 is likely to prove the busiest building season every known. Anticipation of this condition is doubtless reflected in numerous advances which have occurred during January in the prices of various construction materials. The most notable of these, and the one cutting the largest figure in the cost of construction work is the continued gain in cement values. Other concrete materials and common brick also show gains, while manila rope has advanced in every section of the country, and users of automobile trucks are paying generally increased prices for gasoline.

Exports of merchandise set another new record during December, and the activity of general business continues to be extraordinary. Railroad traffic is still heavier than the lines can handle, although the pressure has been relieved to some extent by the fact that a large part of the 1916 crops has been moved to market. Lumber mills in the West report, however, that the car situation continues to be the worst in their experience, and southern lumber mills note but little improvement during the month.

Iron and Steel

The earnings of the United States Steel Corporation, just announced, exceeded for the last quarter of 1916 even the extraordinary records made in the first three quarters of last year, reaching a total of almost $106,000,000 and more than doubling the earnings for the December quarter of 1915. After declaring an extra dividend on its common stock, the corporation still has a surplus of more than $69,000,000 for the quarter.

According to the *Iron Age*, there are as yet no signs of a change to easier conditions in the steel trade. Domestic demand is extending and there is a flood of foreign inquiry for rails, rolling stock and plates. Although the steel-making capacity of the country has been greatly increased, the difficulty of shipping coal, coke and steel products has curtailed production until the present output of pig iron is at a rate below 39,000,000 tons a year. It is not considered likely that production will begin to catch up with demand for some time.

The amount of structural business awarded since the first of the year has surprised even those connected with the trade, many contracts involving large tonnage having been closed. Under the conditions outlined, prices have continued to advance, though the increases are not so general or so marked as those which occurred during December. This is especially true of pig iron, which appears to have settled down at the high figures reached at the beginning of the year.

Pig Iron—Prices per ton recently quoted are as follows:

No. 2x, Philadelphia	**$30.50**
No. 2, Birmingham	**24.00**
No. 2, furnace, Chicago	30.00
Basic, valley furnace	30.00

Steel Products—Prices of steel products given below are per 100 lb. at the mill or warehouse:

	Immediate Delivery	Future Delivery	Warehouse
Pittsburgh:			
Structural material	...	**$3.25**	...
Plates	**$5.00**	3.75	...
Steel bars	...	3.00	...
Iron bars	3.50	3.25	...
Rivets	3.25	4.25	...
New York:			
Structural material	3.669	3.419	$3.95
Plates	5.169	3.919	5.00
Steel bars	3.669	3.169	3.85
Iron bars	...	3.169	**3.70**
Chicago:			
Structural material	**3.689**	**3.439**	**3.85**
Plates	**5.189**	**3.939**	**4.50**
Steel bars	3.439	3.189	**3.75**
Iron bars	3.25	3.00	**3.75**
Rivets	....	4.15	4.50

Sheets—Black sheets, No. 28 gage, have advanced slightly, but galvanized sheets of the same gage remain unchanged. Prices quoted below are per 100 lb. at the points named:

	Black	Galvanized
Pittsburgh	**$4.50**	$6.25
Chicago	**4.75**	6.50

Rails—Prices per ton, f.o.b. the points named, remain as follows:

	Open Hearth	Bessemer
Pittsburgh	$40.00	$38.00
Chicago	40.00	38.00

Cast-Iron Pipe—Prices per ton for cast-iron pipe in carload lots have remained steady during the month at the following figures:

	Class A and Gas Pipe	Class B and Heavier
New York	$42.50	$41.50
Chicago	42.50	41.50
Birmingham	37.00	36.00

Wrought Pipe—Prices in carload lots, f.o.b. Pittsburgh, for lap-welded steel and iron pipe, plain ends, remain as follows:

	Black	Galvanized
Steel pipe, 2½ to 6 in.	$80.00	$105.00
Iron pipe, 2½ to 6 in.	102.00	128.00

Concrete Materials

Cement—Prices have advanced throughout the central and eastern states, apparently under increasing demand and the prospects of a busy season. Those quoted below are to contractors, per barrel, f.o.b. the points named, not including sacks:

Boston	**$2.00**	Duluth	$1.81
New York	**1.67**	St. Paul	1.83
Pittsburgh	**1.66**	Cedar Rapids	1.79
Cleveland	**1.79**	Kansas City	1.64
Atlanta	1.62	Houston	1.65
Cincinnati	**1.80**	Denver	1.99
Detroit	**1.75**	Salt Lake City	2.37
Chicago	1.56	Phoenix	2.85
Jacksonville	1.70	Seattle	**2.20**
New Orleans	**2.10**	San Francisco	2.00
Memphis	1.79	Los Angeles	2.00

Sand—Prices quoted below are in large lots to contractors, f.o.b. the points named:

Boston	$0.80	Houston	$1.00
New York	0.50	Denver	*0.75*
Cincinnati	*0.75	Salt Lake City	0.70
Chicago	**1.25**	Phoenix	1.00
New Orleans	**1.10**	Seattle	0.75
St. Paul	0.50	San Francisco	*0.70
Kansas City	0.60	Los Angeles	0.35

*Per ton.

Gravel and Crushed Rock—A number of advances over prices prevailing at the first of the year are noted. Prices given below are per cubic yard to contractors in large lots, f.o.b the points named:

	Gravel		Crushed Rock	
	¾ in.	1½ in.	¾ in.	1½ in.
Boston	$1.20	$1.10	$1.25	$1.25
New York	....	1.10	1.20	1.10
Cincinnati	*0.75	*0.75	***0.95**	***0.95**
Chicago	**1.25**	**1.25**	**1.15**	**1.15**
New Orleans	1.70	**1.55**	**4.00**	**2.50**

Price advances are indicated by **heavy type**; declines by *italics*.